ACID PRECIPITATION IN ONTARIO STUDY

THE EFFECTS OF ACID PRECIPITATION ON RECREATION AND TOURISM IN ONTARIO

VOLUME II

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BY

CURRIE, COOPER & LYBRAND LTD.

In association with

EARL R. COMBS LTD.
LARRY SMITH & ASSOCIATES

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Submitted By: Currie, Coopers & Lybrand Ltd.
R.J. Simpson
J.E.L. Farrow
In association with
Earl R. Combs Inc.
Larry Smith & Associates Ltd.

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APPENDIX I

CHEMICAL AND BIOLOGICAL EFFECTS OF ACIDIC PRECIPITATION ON THE AQUATIC ENVIRONMENT

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I. CHEMICAL AND BIOLOGICAL EFFECTS OF ACIDIC PRECIPITATION ON THE AQUATIC ENVIRONMENT

The purpose of this appendix is to discuss the chemical and biological effects of acidic precipitation on the aquatic environment. The appendix begins with a discussion of the general effects of acidification on the environment. Next, attention focuses on the four areas of greatest concern to recreation and tourism: the fish population, waterfowl, moose and, finally, human contact activities.

A. CHEMICAL AND BIOLOGICAL EFFECTS

Acidification of the aquatic environment results in widespread damage to the ecosystem. During early stages of the acidification process, major shifts in the biology of the area occur, with different species being affected at each stage of the acidification process. Gradually, the total productivity of the ecosystem will be reduced and, eventually, the effect will be a "pickling" or preserving of the biomass as microbial decomposition is reduced. A few acid tolerant species of moss and algae can continue growth and consequently accumulate in the environment. This accumulation of bio-mass was demonstrated in artificial stream channels by Hendrey (1976).

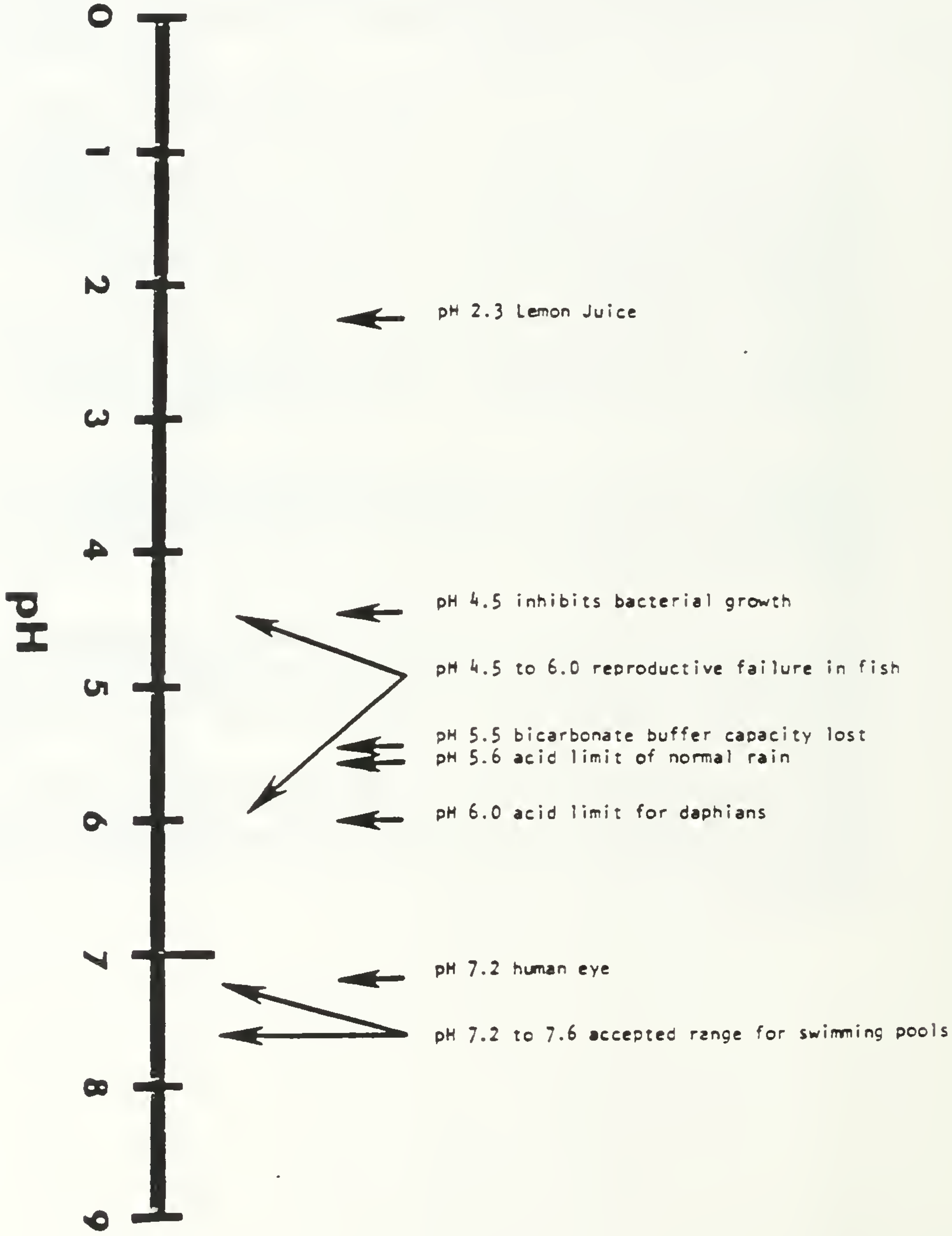
The acidification of the aquatic environment is measured by use of the pH scale. This scale is a logarithmic measure of hydrogen ion concentration and, as such, the rate of pH decline slows as acidification continues. A lake at a pH of 4.0 is 100 times more acidic than a lake at a pH of 6.0.

Due to the carbon dioxide naturally present in the atmosphere, the pH of clean rain in Ontario is about 5.6. At present, the pH of rain over much of Ontario is often found to be in the 4.5 to 4.0 range, meaning that the rain is many times more acidic than clean rain.

Exhibit I-1 indicates some of the significant points in the acidification process. For lakes in Ontario, the critical point begins at a pH of 6.0. At this point, reproductive failure occurs in some species of fish, while, at a pH of 4.5, bacterial growth is inhibited.

EXHIBIT I-1

CRITICAL LEVELS OF pH AND THE AQUATIC ENVIRONMENT


pH
0
1
2
3
4
5
6
7
8
9
pH 2.3 Lemon Juice
pH 4.5 inhibits bacterial growth
pH 4.5 to 6.0 reproductive failure in fish
pH 5.5 bicarbonate buffer capacity lost
pH 5.6 acid limit of normal rain
pH 6.0 acid limit for daphians
pH 7.2 human eye
pH 7.2 to 7.6 accepted range for swimming pools

Source: Earl R. Combs Inc.

While hydrogen ion concentration, expressed as pH, provides a point of reference for the current status of an aqueous system, other factors affect the capacity of the system to resist change in pH. This resistance is termed buffering capacity. If the equation $H+ + HCO_3 \rightleftharpoons H_2CO_3$ represents the equilibrium condition, the ability of additional anion (HCO_3) pushes the equilibrium to the right, while removal of H+ ions will cause increased speciation. This effect is demonstrated in the titration of a buffered solution. Surface waters normally contain additional buffering substances contributing to total buffering capacity. This situation is depicted in the titration curve in Exhibit I-2. Consequently, a buffered alkaline solution can absorb a greater amount of H+ ions before the pH shifts. Conversely, a buffered acid solution can give up more H^+ ions before it will be neutralized. This characteristic greatly influences the effects of acidic precipitation on Ontario's aquatic environment.

B. EFFECTS ON THE FISH POPULATION

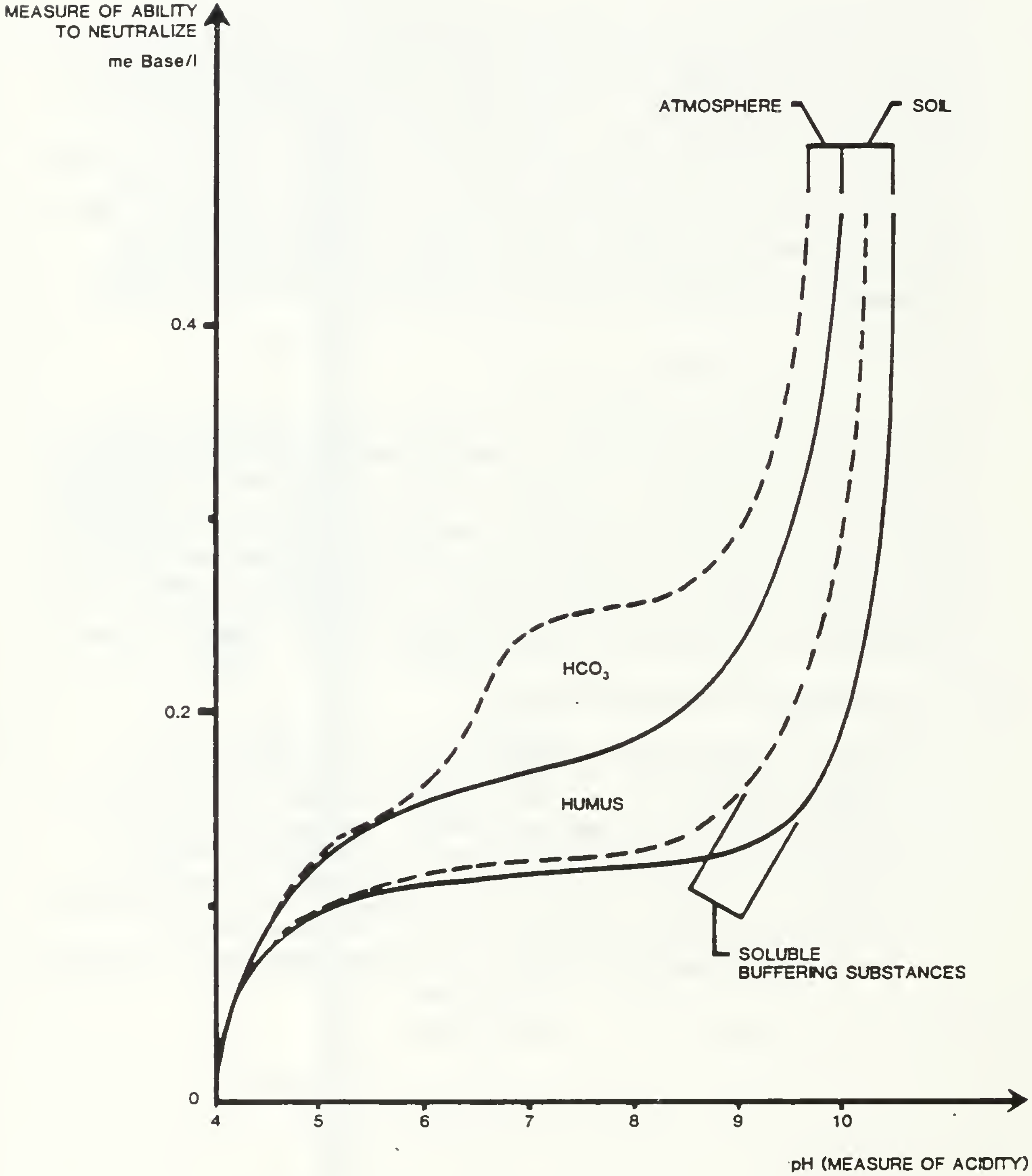
The effects of acidic precipitation on fish reproduction have been well documented (Beamish, 1976). Some of the most desirable fish from a recreational standpoint, smallmouth bass, walleye and lake trout, are among the most sensitive species. Effects on fish may be divided into direct and indirect responses. The direct effects can be further divided into those with immediate reactions and delayed reactions. The indirect effects are also primarily of two types, reduced nutrient cycling and contamination resulting from increased heavy metal solubility. The following section briefly discusses these responses.

1. Direct Effects of Acidification

Direct responses may be immediate (acute), develop after an extended delay as in cancer (chronic), or be somewhere in between, (subacute). The direct acute response to strong acid exposure is tissue damage or necrosis. Sudden acid exposure, even at low concentration, can have acute effects causing a traumatic reaction, termed physiological shock, in aquatic organisms. Juvenile fish are very susceptible to physiological shock. Subacute physiological effects are more common, especially metabolic stress which leads to reproductive failures.

EXHIBIT I-2

COMPONENTS OF BUFFERING CAPABILITY



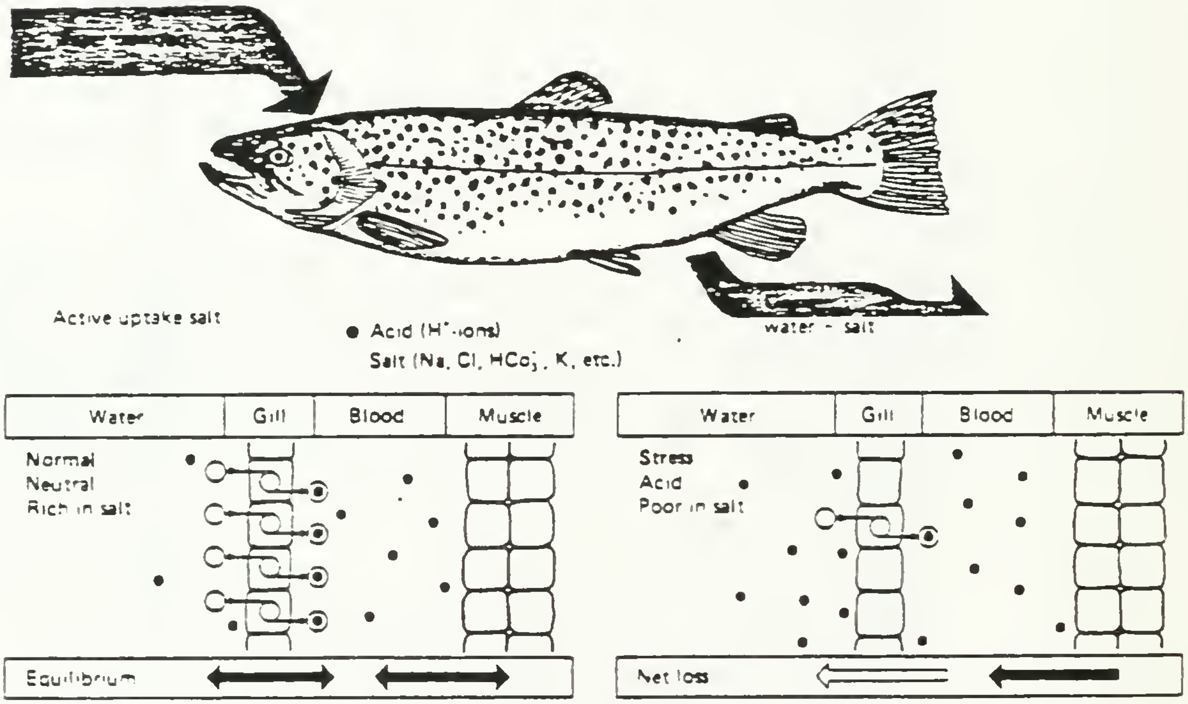
SOURCE : ODEN (1976)

These physiological effects are the result of exceeding the animal's ability to maintain the necessary osmotic concentration in body fluids. Freshwater fish have a higher concentration of salts in their body fluids than in the surrounding environment. Because their body surfaces act as permeable membranes, there is a constant flow of water into the fish created by osmotic pressure. In expelling this water, excretory organs also expel salts and the lost salts must be replaced. This replacement occurs through active transport, an enzymatic process which requires energy. The mechanism is believed to involve an exchange of H+ ions for Na+ and HCO- ions for Cl- (Exhibit I-3). Under conditions of acidification, the increased H+ ion concentration in the water is believed to make the H+/Na+ exchange more difficult, putting stress on the animal's metabolism (Leivestad, et.al., 1976). Calcium is viewed as a critical factor in controlling sodium losses because of its effect on gill permeability (McWilliams, et.al., 1980). Calcium serum level declines have also been correlated to reproductive failures (Beamish, 1976), suggesting that ionic imbalances may be a crucially important factor in the loss of fish.

The reduction in fish populations and the removal of certain species from various lakes have occurred gradually over decades in association with the gradual acidification process. Studies of fish species occurrence in lakes of the La Cloche mountains of Ontario (Harvey, 1975) show a decrease in the number of species with decreased pH. Harvey (1980) estimates that about 200 Ontario lakes have lost fish populations due to acidification. The Norwegian salmon catch data provide a comparative study case. The overall salmon catches declined over this century until the 1940's and subsequently yields have recovered to levels higher than at the start of the century. For seven southern Norwegian rivers, however, the catch data show a continual decline in catch levels, to near zero at present. The declines appear to be caused by recruitment failure. These rivers are unique in that they have low pH levels which appear to be on a continued decline (Leivestad, et.al., 1976). Declines in brown trout populations have prompted additional investigations in Norway. Dovland, et.al (1976) found that the frequency of lakes having suffered losses of trout populations correlated with the acid precipitation deposition patterns. Observations recorded by numerous workers indicate that egg and fry mortalities are the main causes of reproductive failure.

EXHIBIT I-3

WATER AND SALT EXCHANGE IN FRESH WATER FISH



Source: Leivestad et al., "Effects of Acid Precipitation on Freshwater Organisms", Impact of Acid Precipitation on Forest and Freshwater Ecosystems in Norway, Oslo: SNSF Project, 1976

The approximate pH values at which various fish species stopped reproducing in the La Cloche mountain lakes of Ontario are shown in Exhibit I-4. Investigating these lakes, Beamish (1976) observed spawning failure in females which was coincident with a failure to maintain serum calcium levels. He considered high acid concentrations to be the cause.

The west coast of Sweden and the Adirondack Mountains of New York State are other areas where acidification can be related to major losses in fish populations. About 90% of Adirondack lakes with a pH of less than 5.0 no longer have fish in them (Schofield, 1976).

Not all fish losses have been gradual in nature. Massive fish kills due to low pH have occurred. In 1975, the Tovdal River in southern Norway experienced such an event. An early snow melt, suddenly releasing a high concentration of accumulated pollutants, is considered to have been responsible for the kill. The findings of Leivestad and Muniz (1976) demonstrated that low plasma sodium and chloride was associated with the kill. An impairment of the active transport mechanism was believed to be the cause of death. Experiments conducted by Johannessen and Henrikson (1977) demonstrated a 2 to 2.5-fold concentration of pollutants in the first (30%) melt water fraction. The resulting increased acid load in low buffered runoff water is coincidentally released during critical spring hatching periods for some species, thus damaging the sensitive eggs and fry.

2. Indirect Effects of Acidification

Indirect effects of acidification could include loss of nutrient availability plus the increased solubility of heavy metals (Wright et.al, 1980) which can accumulate in the food chain to significant proportions and affect the higher predators. The former occurrence could cause declines in both plant and animal productivity. Plant productivity declines would probably be caused by a reduction in nitrogen fixation and phosphorus availability. Nitrogen is frequently a limiting factor in plant growth.

The findings of Borgstrom and Hendrey (1976) indicated that short term acidification can eliminate important fish or invertebrate species from small lakes. These losses would be expected to reduce productivity of organisms higher up the food chain. Yet, the work of Beamish (1976) suggests this factor is not a major cause of fish loss as predator species such as smallmouth bass, walleye, and lake trout became extinct before the prey species.

EXHIBIT I-4

APPROXIMATE PH AT WHICH REPRODUCTION OF FISH SPECIES CEASES*

	Species
6.0+ to 5.5	Smallmouth bass *Micropterus dolomieui*
	Walleye *Stizostedion vitreum*
	Burbot *Lota Iota*
5.5 to 5.2	Lake trout *Salvelinus namaycush*
	Troutperch *Percopsis omiscomaycus*
5.2 to 4.7	Brown bullhead *Ictalurus nebulosus*
	White sucker *Catostomus commersoni*
	Rock bass *Ambloplites rupestris*
4.7 to 4.5	Lake herring *Coregonus artedii*
	Yellow perch *Perca flavescens*
	Lake chub *Couesius plumbeus*

* developed from Beamish, R.J. "Acidification of Lakes in Canada by Acid Precipitation and the Resulting Effects on Fishes" *Water, Air and Soil Pollution*, v. 6, 1976, p. 501-514.

The second indirect effect of acidification is related to heavy metal activity. Reactivities of various metals can be compared by their location on the periodic table with smaller atomic weight metals being more reactive. Heavy metal pollutants have been documented to have toxic effects on aquatic animals in experimental work. Vertebral deformities have been caused by zinc and cadmium (Bengt, 1975; Larsson, 1975). Chromium exposure (Strik, et.al., 1975) evoked kidney necrosis and intestinal hemorrhages at 10 ppm.

Natural metal contamination can also cause toxic effects on the ecosystem. Soil derived aluminum is leached by acid precipitation. The mobilized aluminum is transported to acidified lakes creating toxic conditions for fish that might otherwise survive. Laboratory studies showed that the toxic effects were most prevalent over a pH range of 4.4 to 5.9 (Cronan and Schofield, 1979).

C. WATERFOWL

Waterfowl have been considered as another likely group to be affected by acidification of Ontario waters. While physical barriers (e.g. feathers and eye membranes) protect these birds from direct effects, they will likely be vulnerable to indirect effects, especially resulting from the decline in nutrient availability. Invertebrate populations change as waters acidify, which can have unusual results on the dependent waterfowl population. Shifts in insect species may cause a local increase or decrease in a particular waterfowl species (Raddum, G.G. et.al, 1980). This effect was noted in the situation studies by Dr. Robert Morris (personal communication) and Nigel Robin of Laurentian University at Sudbury. Midge fly larvae are apparently very acid resistent and when acidification eliminated competitors in one lake, the increased midge fly population attracted large numbers of blue bills (diving ducks).

Losses of invertebrate and fish populations will eventually affect waterfowl, especially during critical periods in the life cycle. During laying periods and juvenile growth stages, the nutritional requirements of waterfowl cause shifts to higher percentages (up to 100% in one instance) of insects in the diet (Bellrose, 1976). Inadequate dietary supplies could reduce fecundity and juvenile survival.

There are three general classes of waterfowl which will each be affected differently. Dr. Lumsden (personal communication) describes them as: 1) puddle ducks, 2) diving ducks, and 3) fishing ducks. During the laying season puddle ducks (e.g. mallard, black duck) feed heavily and lay up to two-thirds of a clutch (which averages nine eggs) at one time, while diving ducks (e.g. gold eye, blue bill) are only producing about three eggs at one time. Consequently, the puddle ducks would be expected to be more sensitive to dietary stress. The mallard and black ducks generally comprise 28% and 14% of the game bird harvest for Ontario, respectively (Canadian Wildlife Service, Species Composition Survey, 1977). As both the puddle ducks and the diving ducks are migratory, they may be found during hunting season in areas which do not support nesting. However, breeding activity might be eliminated from acidified lakes if food sources were greatly diminished. Therefore, it is possible they may be a recreation resource lost from acidified lakes.

While existing population data do not suggest any present effect on these two types of ducks, the situation should be studied further (Collins, 1974). Nonetheless, the third group (fishing birds such as the merganzer and the loon) are territorial species. Mated pairs of these birds establish an area for foraging, breeding and nesting. Populations are limited by the availability of appropriate sites or territories. Loss of fishing grounds will cause a subsequent loss in the order of 14 nests/159 square miles for loons. As these are not game birds, there is no direct loss of recreational opportunity; however, there may be some aesthetic value lost in the enjoyment of the natural environment.

The indirect effects of acidification on waterfowl could eventually reduce populations; this reduction could subsequently have an impact on recreational opportunity for bird hunters and bird watchers but, at present, these effects cannot be quantified.

D. MOOSE

Based on the significance of aquatic derived nutrients to the diet of moose, severe losses of aquatic vegetation due to acidification could possibly affect moose population carrying capacity in Ontario. During the spring and summer, increased sodium requirements are satisfied by feeding on aquatic vegetation which can contain 50 to 500X more sodium than terrestrial vegetation (Botkin, D.B., 1973). The increased sodium requirement is probably caused by the need to rehydrate as an acclimation to warmer weather. Increased moisture losses in the feces and through lactation also contribute to increased sodium need.

As moose are not territorial animals, and range from 10 to 100 kilometers, they would probably adapt to any local loss of feeding grounds by shifting to other areas. Present feeding pressure is low, as evidenced by healthy animals and a high incidence of twin birth (D.G. Fraser, Ontario Ministry of Natural Resources, personal communication). Predation and hunting effort (9,000 to 12,000 animals are harvested per year) keep the herd size below capacity (D.G. Fraser, Ontario Ministry of Natural Resources, personal communication). Current plans to build up the herd size would also increase feeding pressure (Ontario Ministry of Natural Resources, 1980). Consequently, future losses of aquatic vegetation could have more significant effects on this recreational resource.

E. HUMANS

Most of the recreational and tourist activities in the potentially acid-sensitive parts of Ontario involve human contact with water. As a result, any effects of acidification of the aquatic environment which may limit these activities will have widespread effects. The potential effects appear to be of two types - human tissue damage, or changes in the appearance of water bodies as a result of acidification.

Tissue damage from acidified waters has not been documented, but is of concern, especially regarding delicate membranous tissues such as the human eye. Damage from acids is considered to be a combined function of the pH and of the affinity of the anion for protein. Therefore, effects are variable, depending on the particular acid. With hydrochloric acid, for instance, the pH of 1 causes severe damage while no sustained damage occurs at a pH of 3 and above. On the other hand, some buffered acids (e.g., tannic) can produce consistent tissue damage over the range of pH 1.5 to 9 (Casarett and Doull, 1975).

The pH of the eye is normally about 7.2, and some drying or irritation might be expected in acidified waters. The accepted pH range of swimming pools is from 7.2 to 7.6; however, this range reflects more concern for the activity of chlorination than physiological effects. Acidity in swimming pools is guarded against because of increased problems with corrosion as pH decreases. While a pH of 6.5 to 8.5 is recommended for waters used for swimming (Mood, E.W., 1968), there is no present evidence that lower pH's are damaging. Ohio State Park lakes are monitored by the State Environmental Health Department. Lake Hope is acidified by coal mine drainage to pH ranges of 2.8 to 3.4 and no complaints regarding eye or other tissue damage have ever been reported (Tim Hogan, Ohio Recreational Sanitation, personal communication). The use of low pH solutions for eye washes (Raber and Breslin, 1978) has been found to cause some irritation; however, the use of eye washes of pH 4.5 suggests that this pH level is not of major concern for eye tissue.

Initial work by Basu (in review) suggests the measured effects occurring after exposure to water taken from acidified lakes are quickly reversed in most situations, and Basu expressed greatest concern for the sensitive or diseased individual (personal communication).

The oligotrophic acid lakes are considered by some to be quite desirable for swimming due to the extremely clear appearance of the water. On the other hand, algal growth patterns unique to acidified waters can be a nuisance to swimmers. Dense mats of filamentous algae and heavy Sphagnum growths are reported in acidified lakes (Hendrey and Vertucci, 1980). Humic lakes (high in organic acids) have developed noxious odors due to algal blooms which seem to occur selectively in these lakes (Nicholls et.al, in draft).

The most consequential direct effect on humans is apparently the "fear" factor, which is especially significant after recent publicity regarding eye infections. While infectious disease can lead to blindness, the present incidence of blindness caused by all infectious disease is less than 0.2% of total incidence (850 cases in the U.S. in 1978, National Society to Prevent Blindness). Furthermore, the existence of staphylococcus bacteria in the environment is quite high, most children and about 50% of the adult population being staph carriers. Antibiotic resistent strains of staph organisms are a prevalent problem in hospitals, and the incidence of carriers among hospital personnel is probably higher (Hoeprich, 1972). One could then argue that working in a hospital may be more dangerous than swimming in an acid lake. The concern with blindness from swimming in acid lakes must be considered in relation to other human risks. Certainly death from accidental drowning is a more immediate danger (5,645 cases in the U.S. in 1978, Statistical Abstracts). Consequently, the concern for eye effects will not be evaluated with actual ecosystem impacts from acidification.

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APPENDIX II

ESTIMATING THE AMOUNT OF AQUATIC BASED RECREATION AND TOURISM ACTIVITY IN ONTARIO

APPENDIX II

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II. ESTIMATING THE AMOUNT OF AQUATIC BASED RECREATION AND TOURISM ACTIVITY IN ONTARIO

The purpose of this appendix is to estimate the amount of aquatic-based recreation occuring in Ontario, by region, in 1980. As the information available and the use patterns differ significantly between residents and non-residents and day-use and overnight activity, these divisions have been used to estimate 1980 activity. As a result, this appendix has been divided into three major sections focusing on residents, non-residents, and the regional situation. Within each of these sections, estimates are made of home-based and overnight activities for each of the main aquatic-based recreation activities.

- swimming (natural environment only)
- boating
- fishing
- water skiing
- scuba and skin diving
- waterfowl hunting

One other activity, moose hunting, is also of concern. Due to data availability, this activity has been handled separately on the basis of licence information.

Throughout this analysis, day use is estimated, based on occasions of activity, while overnight activity has been estimated on the basis of activity nights.

A. ESTIMATING THE AMOUNT OF RESIDENT, AQUATIC-BASED RECREATION AND TOURISM IN ONTARIO

The comprehensive Ontario Recreation Survey* provides an excellent picture of recreation occasions for the 1973-1974 period, and is an excellent base for estimating current activity.** The data base developed from this survey is based upon over 10,000 scientifically conducted personal interviews of Ontario residents conducted during the May 1, 1973 to April 30, 1974 period. The main purpose of the Ontario Recreation Survey was to provide comprehensive and valid information on recreation and tourism in Ontario. It is the only comprehensive attempt to understand tourism and recreation in Ontario and is one of the most comprehensive surveys of its type ever attempted. Eight volumes have been published concentrating on the highlights of this survey. In addition, the data are available in computerized form through the Leisure Studies Data Bank at the University of Waterloo. As a result the data can be further analyzed as has been necessary for this study.

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* To access this information, use was made of the Leisure Studies Data Bank, University of Waterloo.

** Throughout this appendix, all figures refer to Ontario's total population, not just the population surveyed in the Ontario Recreation Survey.

1. Estimating Non-Home Based Recreation Activity

As indicated in Exhibit II-1, a great many occasions of aquatic-based recreation activity occurred during weekend and vacation trips during 1973-74, estimated at 78,888,000. However, this figure cannot be used to estimate the total number of nights away from home as the method of collecting this information allows for respondents to indicate participation in more than one activity per day on a vacation or weekend trip.

During the Ontario Recreation Survey period, there were a great many nights away from home on weekend and vacation trips. Of the total of 137,318,000 million nights, 92,682,000 occurred in Ontario during the 1973-74 period.

From the Ontario Recreation Survey, it can be determined that, of the total activities undertaken on weekend and vacation trips, aquatic-related recreational activities* accounted for approximately 37% of the 214 million occasions for all types of activities during 1973-74. In order to determine the number of nights directly attributable to various types of aquatic-based activity, we assumed that each of the aquatic based activities would be the main motivation for the overnight stay in proportion to its share of the total recreation occasions occurring on overnight trips.

	Occasions Occuring on an 1973-74 Overnight Trip (000's)	% of Total
Swimming (natural environment)	35,646	16.6
Boating	21,030	9.8
Fishing	15,205	7.1
Water Skiing	5,674	2.6
Scuba Diving	1,146	0.5
Waterfowl Hunting	187	0.1
Total Aquatic	78,888	36.8
Total Recreation Occasions	214,367	100.0

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* Included are visiting friends and relatives, sightseeing, shopping and about 70 other activities. Activities associated with business travel are excluded.

EXHIBIT II-1

ESTIMATED NUMBER OF OCCASIONS OCCURRING ON OVERNIGHT TRIPS (000's)
1973-74*

	Total Occasions Occurring on a Overnight Trip	% of Total
Swimming (natural) environment	35,646	45%
Boating	21,030	27%
Fishing	15,205	19%
Water Skiing	5,674	7%
Scuba Diving	1,146	1%
Waterfowl Hunting	187	0.2%
Total Aquatic-oriented	78,888	100%

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* estimated from the Ontario Recreation Survey

As indicated below, aquatic-based recreation and tourism accounts for an estimated 39,005,000 overnight stays by residents of Ontario in 1980, based on the results of the Ontario Recreation Survey.

	Estimated Number of Nights 000's 1980
Swimming (natural environment)	17,661
Boating	10,428
Fishing	7,555
Water Skiing	2,767
Scuba Diving	491
Waterfowl Hunting	103
Total Aquatic Base	39,005

The 1980 figures have been estimated by increasing the 1974 estimates at the rate of population growth for the Ontario population twelve years and older during the 1974-1980 period of 14.8%*. This method of estimating 1980 activity has been used as there is little evidence to suggest that participation in weekend and vacation trips in the province has been subject to growth rates higher than that explainable by population growth. Trends in recreation and tourism activity are discussed in Appendix IV.

2. Estimating Residents Day-Use Activity

Resident day-use activity is also based upon the Ontario Recreation Survey. As with overnight trips, 1980 occasions have been estimated by increasing the 1974 figures by the 1974-80 rate of growth of the population over twelve years of age. Exhibit II-2 summarizes these calculations.

B. ESTIMATING THE AMOUNT OF NON-RESIDENT, AQUATIC-BASED RECREATION AND TOURISM IN ONTARIO

The task of estimating 1980 aquatic-based recreation and tourism activities of non-residents of Ontario is also very complex and no one direct source of this information exists. To make these types of estimates, it is necessary to rely on a number of data sources, principally Ontario Tourism Statistical Handbook's for various years and the 1974 Survey of U.S. Automobile Visitors to Ontario. This section outlines the procedures used to estimate both the overnight as well as the day-use aquatic-based recreation and tourism activity.

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* estimated from Ministry of Treasury and Economics estimates of 1980 Ontario population.

EXHIBIT II-2

ESTIMATED NUMBER OF OCCASIONS (000's) OF RESIDENT DAY USE ACTIVITY

Activity	Home Based Occasions (000's)	
	1973-74*	1980
Swimming (natural environment)	23,327	26,779
Boating	11,312	12,986
Fishing	12,925	14,838
Water Skiing	1,236	1,419
Scuba Diving	107	123
Waterfowl Hunting	267	306
Total Aquatic Oriented	49,174	56,451

* estimated from the Ontario Recreation Survey, 1980 estimated by increasing 1973-74 estimates at the rate of population growth.

1. Estimating Number of Visitor Nights

In order to estimate the economic importance of non-resident aquatic-based activity, it is first necessary to estimate the number of non-resident tourists nights. Three separate categories of visitors were used in these estimates.

i) United States Residents

Estimates of the number of American residents are provided by Statistics Canada in Travel Between Canada and Other Countries (66-001). As indicated below, the number of U.S. residents entering Canada has declined and remained at low levels from 1976 on.

1973	23,298,147
1974	22,785,652
1975	22,375,536
1976	20,754,734
1977	20,699,086
1978	20,632,489
1979	20,879,079
1980	25,681,291

Preliminary indications suggest that 1980 will reverse this trend, with a significant increase as indicated by the January - September, 1980, figure for Canada showing a 23% gain over the January - September, 1979, figure. For 1980, we have assumed this 23% increase in our Ontario estimate.

Most of these visitors, however, are day trippers, estimated at 67%*. It is also our view that the substantial growth in the numbers of U.S. residents entering Canada in 1980 consists mainly of day trippers who are attracted by lower prices for shopping and gasoline. As a result, our estimate of the number of Americans entering Canada and staying one or more nights is 6,890,000**.

One step still remains to complete the calculation of total U.S. visitor nights. This is accomplished by multiplying the number of visitors by the total length of stay, estimated at 3.6 days*. Thus the total number of United State resident visitor nights in Ontario for 1980 is estimated at 24,804,000 nights.

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* Based upon ratio of total U.S. vehicles entering Ontario to the total staying one or more nights in 1979. Ontario Ministry of Treasury and Economics Ontario Statistics, 1980 p. 261.

** 33% of the 1979 total U.S. residents entering Canada.

ii) Other Foreign Visitors

Statistics Canada also provides estimates of the number of residents of countries other than the United States entering Ontario. With the exception of the 1976-77 period, there has been steady growth in the number of non-resident travellers other than Americans entering Ontario.

	Residents of Countries Other** than the U.S. Entering Canada
1973	656,324
1974	674,834
1975	732,427
1976	885,281
1977	800,970
1978	942,920
1979	1,161,101
1980e	1,253,880 (based on first 9 months)

These figures include both overnight stays and day visits. Statistics Canada estimated that the 885,281 visitors entering Ontario generated an estimated 9,358,000 person nights in 1976***. Using this relationship and the 1980 estimate of residents of countries other than the U.S.A. entering Canada an estimate of other non-resident visitor nights of 13,253,000 was derived.

iii) Other Canadians

The Ontario Ministry of Industry and Tourism estimates that residents of other provinces made 11.2 million person trips into Ontario during 1978. As indicated below, this number has been growing steadily.

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* Ontario Tourism Research Branch U.S. Automobile Visitors to Ontario, 1974.

** Statistics Canada, Travel Between Canada and Other Countries (66-001), as reported in Ontario Ministry of Treasury and Economics, Ontario Statistics, 1980 p. 259.

*** Statistics Canada Travel Tourism and Outdoor Recreation, 1979 and 1977 Catalogue 66-202 p. 138.

	Person Trips From* Other Provinces (000's)
1972	7,100
1973	7,600
1974	8,400
1975	9,100
1976	9,900
1977	10,700
1978	11,200
1979e	12,096
1980e	13,064

More recent estimates than 1978 are not available so that the 1980 number of person trips from other provinces has been projected, based upon the 1972-78 average annual growth of 8%.

There is no information which indicates the number of person-trips that involved a overnight stay. An estimate of these was made, based upon the patterns exhibited by United States visitors to Ontario. It was thus estimated that 33% of the person trips involved an overnight stay and that the average length of stay was 3.6 days. Thus, residents of other provinces account for an estimated 15,520,000 visitor nights in Ontario.

To conclude non-residents account for a significant number of visitor nights in Ontario in 1980, estimated at 53,577,000.

	Visitor Nights 000's	%
United States	24,804	46
Other Foreign	13,253	25
Other Canadian	15,520	29
Total	53,577	

2. Estimating Number of Day Trips

In addition to over-night visitors, non-residents are also likely to participate in aquatic-based recreation on a day-use basis. As with overnight visitors, no direct source of data exists and, thus, it is necessary to estimate the number of non-resident, home-based person trips.

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* Ontario Ministry of Industry and Tourism Tourism Statistical Handbook May, 1979 p. 13.

i) United States Residents

As previously discussed, 67% of visits to Ontario by United States residents were day trips. Therefore, in 1979, there were 13,989,000 day trips by American residents. Throughout this study, the 1979 estimates will be used for 1980 because the extremely sharp increase in American visitors will not be reflected in early studies of activities, accommodation and expenditures.

ii) Other Foreign Residents

In 1976, Statistics Canada estimated that there were 218,500 other foreign residents entering and leaving Canada on the same day*. The 1980 estimate is 310,000, based upon the overall growth rate of other foreign resident visits.

iii) Other Canadians

An estimated 8,753,000 day trips were taken in 1980 in Ontario by other Canadians. This estimate is the residue of the total trips, less those with a stay of one or more nights.

Therefore, the total number of non-resident day trips is estimated at 23,052,000.

	Person-Trips 000's	%
United States	13,989	61
Other Foreign	310	1
Other Canadian	8,753	38
Total	23,052	

3. Estimating Aquatic-based Recreation and Tourism Activity

The classification of non-resident tourist used in the previous section will be helpful in estimating aquatic-based recreation activity as the reasons for visiting Ontario. The types of activities participated in vary for each group.

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* Statistics Canada Travel, Tourism and Outdoor Recreation 1976 and 1977 66-202 p. 139.

i) Overnight Visitors

Overnight non-resident visitors have basically been treated in the same way as resident overnight visitors. From several different sources, the percentage of overnight stays for the main purpose of recreation was estimated.

United States	32%*
Other Foreign	26%**
Other Canadian	32%***

These figures were then applied to the estimated 1980 visitor nights to determine the number of recreation-related overnight stays. The following table outlines the derivation of these estimates.

1980 Non-Resident Overnight Stays

	Total for All Purposes (000's)	% for Recreational Purposes	Number for Recreational Purposes (000's)	% of Total Non-Resident Overnight Stays (recreation purposes)
United States	24,804	32%	7,937	49%
Other Foreign	13,253	26%	3,446	21%
Other Canadian	15,520	32%	4,966	30%
TOTAL	53,577		16,349	100%

The next step is to estimate the number of nights directly attributable to various types of aquatic-based recreation activity. For this, the only data available relate to

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* Ontario Tourism Research Branch U.S. Automobile Visitors to Ontario 1974, April, 1976, Table 6, total of the categories: outdoor recreation, own cottage, Ontario resort vacation and tour Ontario countryside.

** Ontario Ministry of Industry and Tourism Tourism Statistical Handbook, 1979 p. 50, estimate based on 1977 other pleasure recreation and holiday category.

*** Same estimate as used for United States residents.

United States residents*. Estimates were made, based upon the assumption that the main purpose of the recreation-related overnight stay was proportional to the rate of participation in the recreation activities. The patterns for U.S. visitors were applied to all three groups of non-resident overnight visitors. Exhibit II-3 summarizes these calculations. As indicated in this Exhibit aquatic activities accounted for 51.28% of these overnight stays. Fishing accounts for 25% of the total non-resident overnight stays.

ii) Day Use

Non-resident day use activity has been treated in the same way as that for non-resident overnight visitors. From several different sources, the percentage of day trips for the main purpose of recreation was estimated:

United States	12%**
Other Foreign	9%***
Other Canadian	12%****

These figures were then applied to the estimated 1980 number of day trips to determine the number of day trips for outdoor recreation purposes. The following table summarizes the derivation of these estimates.

1980 Non-Resident Days Trips

	Total for All Purposes	% for Recreational Purposes	Number for Recreational Purposes	% of Total Non-Resident Day Trips for Recreational Purposes
United States	13,989	12%	1,679	61%
Other Foreign	310	9%	28	1%
Other Canadian	8,753	12%	1,050	38%
TOTAL	23,052		2,757	100%

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* Ontario Tourism Research Branch U.S. Automobile Visitors to Ontario 1974 estimated from Table 8.

** Ontario Tourism Research Branch U.S. Automobile Visitors to Ontario 1974, April, 1976, Table 6, total of the categories outdoor recreation, own cottage, Ontario resort vacation and tour Ontario countryside for day visitor parties.

*** Estimate based on same proportion to United States visitors as overnight.

**** Same estimate as used for United States residents.

EXHIBIT II-3

ESTIMATED 1980 OVERNIGHT AQUATIC-BASED RECREATION ACTIVITY

BY NON-RESIDENTS (000's)

	U.S.	Other Foreign	Other Cdn.	Total	% of Total
Total of all types of recreation nights	7,937	3,446	4,966	16,349	100%
Fishing	1,984	861	1,241	4,086	25%
Boating	1,111	482	695	2,288	14%
Swimming (natural environment)	794	345	497	1,636	10%
Waterskiing	159	69	99	327	2%
Scuba Diving	16	7	10	33	.2%
Waterfowl Hunting	6	3	4	13	.08%
Total aquatic	4,070	1,767	2,546	8,383	51.28

EXHIBIT II-4

ESTIMATED NUMBER OF DAY USE OCCASIONS FOR AQUATIC-BASED RECREATION ACTIVITY BY NON-RESIDENTS (000's) 1980

	U.S.	Other Foreign	Other Cdn.	Total	% of Total
Total of all types of recreation nights	1,679	28	1,050	2,757	100%
Fishing	420	7	262	689	25%
Boating	235	4	147	386	14%
Swimming (natural environment)	168	3	105	276	10%
Waterskiing	34	1	21	56	2%
Scuba Diving	3	-	2	5	.2%
Waterfowl Hunting	1	-	1	2	.08%
Total aquatic	861	15	538	1,414	51.28%

The next step is to estimate the participants in the aquatic based activity. As with overnight non-residents, the only data available relate to United States residents. Estimates were made, based upon the same proportions as developed for overnight stays*. The patterns for U.S. visitors were applied to all three groups of non-resident overnight visitors. Exhibit II-4 summarizes these calculations.

C. ESTIMATING REGIONAL RECREATION AND TOURIST ACTIVITIES

As acidic precipitation is a problem that will vary by region it is necessary to develop regional estimates of recreation and tourist activities. The method for developing regional estimates varied between resident use and non-resident use. Estimates were developed for five areas of the province.

1. Key Acid Sensitive Tourist Area of Southern Ontario

Consisting of the Regional District of Muskoka, the District of Parry Sound and the county of Haliburton.

2. Acid Sensitive Eastern Ontario

Consisting of the counties of Peterborough, Hastings, Lennox and Addington, Frontenac, and Renfrew.

3. Northeastern Ontario

Consisting of the districts of Nipissing, Algoma, Sudbury, Manitoulin, Timiskaming and Cochrane.

4. Northwestern Ontario

Consisting of the districts of Kenora, Rainy River and Thunder Bay.

5. Non-Sensitive Ontario

Consisting of the following counties and regional municipalities Essex, Kent, Lambton, Huron, Middlesex, Elgin, Haldimand-Norfolk, Oxford, Perth, Huron, Bruce, Grey, Wellington, Waterloo, Brant, Niagara, Hamilton-Wentworth, Halton, Peel, Dufferin, Simcoe, York, Metro Toronto, Durham, Victoria, Northumberland, Prince Edward, Leeds, Lanark, Ottawa-Carleton, Stormont, Glengarry, Prescott, Russell, Dundas and Grenville.

Additional subdivision would have been desirable, but much of the available information does not allow for additional divisions by user group.

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* Ontario Tourism Research Branch U.S. Automobile Visitors to Ontario 1974 estimated from Table 8.

1. Estimating Resident Regional Activity

Both overnight and day-use activities by Ontario residents were estimated from the Ontario Recreation Survey for each of the five areas. The regional and provincial estimates for 1980 activity are based upon print-outs developed by the Leisure Studies Data Bank, University of Waterloo. These estimates have been modified slightly to reflect the entire population of Ontario, not just the surveyed population. In addition they have been updated to 1980 by use of the population factor discussed earlier in this appendix. No modification were made in the 1973-74 Regional distribution patterns. Exhibit II-6 - II-10 contain the 1980 estimates, by region, by activity, for day-use occasions and overnight stays.

Small discrepancies exist between the total of the regions and the provincial total. These have resulted due to rounding in the original computer print-outs.

2. Estimating Non-resident Regional Activity

No good estimates exist of non-resident regional tourist and recreation participation in aquatic-based recreation and tourist activities. As a result, the non-resident participation was distributed, based upon the regional patterns of Ontario residents. However, one exception was made. Fishing activity was distributed, based upon patterns derived from the 1975 Angler Survey. Thus the procedure for estimating regional non-resident activity consisted of the following steps.

- The total provincial estimates of 1980 non-resident day use by activity and overnight stays by activity as developed in this appendix were used as the base.
- Next, the regional proportions of day use and overnight stays by activity were calculated based upon the pattern for Ontario residents as exhibited in the Ontario Recreation Survey. For fishing, the following more recent regional patterns estimated from the 1975 Angler Survey were used.

	Day Use	Overnight
Parry Sound, Muskoka, Haliburton	6%	6%
Acid Sensitive Eastern Ontario	15%	15%
Northeastern	12%	13%
Northwestern	52%	48%
Remainder of Province	16%	18%

- These proportions were then applied to the 1980 estimates of non-resident activity.

Exhibits II-5 - II-10 contain the 1980 estimates of non-resident activity by region.

EXHIBIT II-

ESTIMATED ACTIVITY, HOME-BASED AND OVERNIGHT FOR THE PROVINCE OF ONTARIO

(all figures 000's)

HOME-BASED OCCASIONS

Activity	Resident	Non-resident U.S.	Other Foreign	Other Canadian	Total	Tota
Swimming (natural environment)	32,135	168	3	105	276	32,4
Boating	15,583	235	4	147	386	15,9
Fishing	17,806	420	7	262	689	18,4
Water Skiing	1,703	34	1	21	56	1,7
Scuba Diving	148	3	-	2	5	1
Hunting - waterfowl	367	1	-	1	2	3
Total	67,742	861	15	538	1,414	69,1

OVERNIGHT STAYS

Activity	Resident	Non-resident U.S.	Other Foreign	Other Canadian	Total	Tota
Swimming (natural environment)	17,661	794	345	497	1,636	19,2
Boating	10,428	1,111	482	695	2,288	12,7
Fishing	7,555	1,984	864	1,241	4,089	11,6
Water Skiing	2,767	159	69	99	327	3,0
Scuba Diving	491	16	7	10	33	5
Hunting - waterfowl	103	6	3	4	13	1
Total	39,005	4,070	1,770	2,546	8,386	47,3

EXHIBIT II-6

ESTIMATED ACTIVITY, HOME-BASED AND OVERNIGHT, FOR PARRY SOUND, MUSKOKA AND HALIBURTON - 1980

(all figures 000's)

HOME-BASED OCCASIONS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	1,928	10	-	6	16	1,944
Boating	1,169	18	-	11	29	1,198
Fishing	1,247	34	1	5	40	1,287
Water Skiing	95	2	-	1	3	98
Scuba Diving	44	1	-	1	2	46
Hunting - waterfowl	73	-	-	-	-	73
Total	4,556	65	1	24	90	4,646

OVERNIGHT STAYS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	3,179	143	62	89	294	3,473
Boating	2,920	311	135	195	641	3,561
Fishing	1,339	159	69	25	253	1,592
Water Skiing	655	38	17	24	79	734
Scuba Diving	58	2	1	1	4	62
Hunting - waterfowl	64	4	2	2	8	72
Total	8,215	657	286	336	1,279	9,494

Note: Data may not add to provincial totals due to rounding.

EXHIBIT II-7

ESTIMATED ACTIVITY, HOME-BASED AND OVERNIGHT, FOR ACID SENSITIVE EASTERN ONTARIO

(all figures 000's)

HOME-BASED OCCASIONS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	4,627	24	-	15	39	4,666
Boating	2,618	39	1	25	65	2,683
Fishing	3,026	71	1	29	101	3,127
Water Skiing	484	10	-	6	16	500
Scuba Diving	1	-	-	-	-	1
Hunting - waterfowl	11	-	-	-	-	11
Total	10,767	144	2	75	221	10,988

OVERNIGHT STAYS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	2,120	95	41	60	196	2,316
Boating	1,877	200	87	125	412	2,289
Fishing	1,306	337	147	137	621	1,927
Water Skiing	352	21	9	13	43	395
Scuba Diving	47	1	1	1	3	50
Hunting - waterfowl	8	-	-	-	-	8
Total	5,710	654	285	336	1,275	6,985

Note: Data may not add to provincial totals due to rounding.

EXHIBIT II-8

ESTIMATED ACTIVITY, HOME-BASED AND OVERNIGHT, FOR NORTHEASTERN ONTARIO - 1980

(all figures 000's)

HOME-BASED OCCASIONS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	3,920	20	-	13	33	3,953
Boating	1,729	26	-	16	42	1,771
Fishing	2,492	71	1	10	82	2,574
Water Skiing	251	5	-	3	8	259
Scuba Diving	4	-	-	-	-	4
Hunting - waterfowl	4	-	-	-	-	4
Total	8,400	122	1	42	165	8,565

OVERNIGHT STAYS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	2,471	111	48	70	229	2,700
Boating	1,564	167	72	104	343	1,907
Fishing	1,454	337	147	50	534	1,988
Water Skiing	366	21	9	13	43	409
Scuba Diving	180	5	2	3	10	190
Hunting - waterfowl	11	1	-	-	1	12
Total	6,046	642	278	240	1,160	7,206

Note: Data may not add to provincial totals due to rounding.

EXHIBIT II-9

ESTIMATED ACTIVITY, HOME-BASED AND OVERNIGHT, FOR NORTHWESTERN ONTARIO - 1980

(all figures 000's)

HOME-BASED OCCASIONS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	1,318	7	-	4	11	1,329
Boating	1,262	19	-	12	31	1,293
Fishing	1,781	139	2	215	356	2,137
Water Skiing	32	1	-	-	1	33
Scuba Diving	-	-	-	-	-	-
Hunting - waterfowl	22	-	-	-	-	22
Total	4,415	166	2	231	399	4,814

OVERNIGHT STAYS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	531	24	10	15	49	580
Boating	418	44	19	28	91	509
Fishing	391	655	285	1,018	1,958	2,349
Water Skiing	50	3	1	2	6	56
Scuba Diving	-	-	-	-	-	-
Hunting - waterfowl	5	-	-	-	-	5
Total	1,395	726	315	1,063	2,104	3,499

Note: Data may not add to provincial totals due to rounding.

EXHIBIT II-10

ESTIMATED ACTIVITY, HOME-BASED AND OVERNIGHT, FOR REMAINDER OF ONTARIO - 1980

(all figures 000's)

HOME-BASED OCCASIONS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	20,341	106	2	66	174	20,515
Boating	8,804	133	2	83	218	9,022
Fishing	9,259	105	2	3	110	9,369
Water Skiing	841	17	1	10	28	869
Scuba Diving	99	-	-	-	-	99
Hunting - waterfowl	258	1	-	1	2	260
Total	39,602	362	7	163	532	40,134

OVERNIGHT STAYS

Activity	Resident	Non-resident				Total
		U.S.	Other Foreign	Other Canadian	Total	
Swimming (natural environment)	9,360	421	183	263	867	10,227
Boating	3,649	389	169	243	801	4,450
Fishing	3,065	496	216	11	723	3,788
Water Skiing	1,344	78	34	49	161	1,505
Scuba Diving	206	7	3	5	15	221
Hunting - waterfowl	15	1	1	1	3	18
Total	17,639	1,392	606	572	2,570	20,209

Note: Data may not add to provincial totals due to rounding.

APPENDIX III

ESTIMATING THE ECONOMIC IMPORTANCE OF AQUATIC-BASED RECREATION AND TOURISM IN ONTARIO

APPENDIX III

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III. ESTIMATING THE ECONOMIC IMPORTANCE OF AQUATIC-BASED RECREATION AND TOURISM IN ONTARIO

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III. ESTIMATING THE ECONOMIC IMPORTANCE OF AQUATIC-BASED RECREATION AND TOURISM IN ONTARIO

No estimates of the economic value to Ontario of aquatic-based recreation and tourism activity exist. As a result, it has been necessary to develop a method to calculate the economic value of these activities. This was done on the basis of an expenditure approach. Thus, for each of the seven major forms of aquatic-based recreation and tourism activities, average levels of expenditure have been calculated. Home-based activities have been estimated by activity, while activities associated with overnight stays have been estimated by major category of accommodation used.

This appendix discusses how the expenditures estimates were determined, and presents the details for calculating the value of aquatic-based recreation and tourism for six regions and the province. Comments concerning the methods for calculating indirect expenditures and employment estimates as well as the type of expenditures are also included.

In addition to occasion and overnight stay expenditures there are also expenditures generated for the purchase of durables such as automobiles, private cottages and major recreational and sports equipment. Expenditures on these items are normally excluded from estimates of tourist and recreation expenditures.* This type of expenditure has also been excluded from the evaluation framework developed here. In the future, as acidification becomes more widespread, expenditures on durables could be affected. The last section of this appendix briefly discusses available information relating to these expenditures and some of the problems associated with developing estimates for these expenditures.

A. Estimating Expenditures on Aquatic-Based Recreation and Tourism in Ontario

Numerous studies have been undertaken to determine the expenditures of recreation participants and tourists. Normally, these studies have involved sample surveys of householders, of tourist parties, of participants, of passengers on various types of transportation, or combinations of the above. Exhibits III-1 - III-5 summarize the important details of the available studies.

For the most part, it has not been possible to use expenditure patterns directly from available studies. Instead, the majority of estimates developed for use in this study are a synthesis of available studies, the Ontario Recreation Survey, and judgments. All figures cited have been converted to June, 1980, dollars. In addition, only spending directly related to the trip, such as expenditures on food, fuel, lodging, guide services, licences and permits are included in the expenditure estimates. Excluded are expenditures on major equipment (purchase, maintenance, repair, depreciation, and insurance) as well as the costs associated with cottage maintenance.

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* See for example the Ministry of Industry and Tourism, Economic and Social Importance of Ontario Tourism, prepared by Larry Smith & Associates Ltd., March 1978.

1. Home-based Expenditures

These expenditures have been estimated on the basis of type of activity. The expenditure levels generated have been applied to both resident and non-resident participants.

a. Swimming (natural environment)

Expenditures on outdoor swimming are estimated at $3.71 per occasion in the Crown Land study.* As a further source, the 1979 Provincial Parks Day User Survey was examined. After "relaxing", swimming is the major activity of park users. Thus, park day-user expenditures are reasonably representative of swimming day-use spending. Average expenditures per person per day within 25 miles of the park were estimated at $4.18.** Making an upward adjustment to this figure (to include all trip-related expenditures, not just those within 25 miles of the park) yields an estimate of $5.00 per swimmer per day-use day.

b. Boating

Boating expenditures have been estimated at $7.42 per boating occasion in the Crown Land Recreation Study, identical to the estimate made for fishing.*** According to the Ontario Recreation Survey, the distances travelled for day-tripping where the major activity is boating are quite similar to distances travelled on fishing day-trips so there would be little difference in terms of travel costs.**** Since major equipment purchase, maintenance and repair are not included in our expenditure estimates, there would be no difference between fishing and boating due to this factor. A possible difference in terms of fuel consumption while participating in the activity is also considered minimal as not all fishing is done on boats and not all boating uses fuel (e.g. sailing, canoeing). In summary, then, it is reasonable to expect that the $8.00 figure used for fishing would also be applicable to boating.

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* Ontario Ministry of Natural Resources Crown Land Recreation Study Phase I, June 1977, p. 39.

** Ontario Ministry of Natural Resources, Parks and Recreational Area Branch 1979 Provincial Parks Day User Survey, 1979, pp. 31-33.

*** Ontario Ministry of Natural Resources Crown Land Recreation Study Phase I, June 1977, p. 39.

**** Ontario Tourism and Outdoor Recreation Planning Study Committee Tourism and Recreation Behaviour of Ontario Residents - Volume 3, pp. 179-180.

c. Fishing

An estimated daily expenditure figure of $8.00 per angler appears most appropriate for use in this study. This expenditure level is based upon three studies of angler expenditure patterns. Estimates of fishing expenditures in Ontario are provided in three studies undertaken by the Ontario Ministry of Natural Resources: the Ontario Angling study, Angler Survey and the Crown Land Recreation Study. In 1980 dollars, Ontario residents' expenditures per occasion were $12.26* and $8.30** respectively, for the first two studies, while the Crown Land Study had a lower estimate of $7.42 per fishing occasion.*** All of these studies include both home-based and overnight occasions. The Ontario Angling study estimate is higher as it also includes expenditures on boat maintenance and fishing equipment. For purposes of this study, the average expenditure per home-based fishing occasion is estimated at $8.00 per occasion.

d. Waterskiing

There are no studies on expenditures associated with waterskiing. To estimate these expenditures, the boating expenditure of $8.00 per day has been increased by $2.00 to compensate for the greater fuel expenditure. Thus, expenditures on home-based waterskiing are estimated at $10.00 per participant per home-based occasion.

e. Scuba Diving

Expenditures on home-based scuba diving occasions are estimated based on discussions with the Ontario Underwater Council. It costs approximately $3.00 to fill a scuba tank with air, and one tankful is normally used per dive. Assuming an average of two dives per occasion, this component of daily costs would be $6.00. Boats are often chartered to take divers to their destinations, usually shipwrecks; this costs approximately $20.00 per day per diver. However, many dives are made without the use of a charter boat; this component for food and transportation of $9.00 (slightly higher than for boating and fishing due to the relatively long distances travelled in day-use, and the non-family nature of the sport) results in an estimate of total expenditures of $25.00 per diver per occasion.

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* Ontario Ministry of Natural Resources Ontario Angling, 1970.

** Ontario Ministry of Natural Resources Angler Survey, 1975, draft copy, p. 34.

*** Ontario Ministry of Natural Resources Crown Land Recreation Study Phase I, June 1977, p. 39.

f. Waterfowl Hunting

According to the Ontario Recreation Survey, hunting on day-trips mainly takes place within one hour of home.* According to the United States 1970 National Survey of Fishing and Hunting, average expenditure per waterfowl hunter per day were $21.01, in 1980 Canadian dollars.** The Crown Land study estimate is $27.81 per hunter per occasion.*** These figures are overstated for our purposes because they include equipment expenditures and overnight trips. Considering these factors, our estimate of home-based waterfowl hunting expenditures is $12.00 per occasion.

g. Moose Hunting

The Ontario Recreation Survey does not classify moose hunting as a separate category. As a result, it is not possible to separate this activity into home-based and non-home-based activity. As participation in this activity has a short, intensive pattern, we have assumed that the majority of this activity is associated with an overnight stay and have thus allocated all expenditures to this category.

2. Overnight Expenditures

As previously discussed, expenditures on overnight trips vary most according to the type of accommodation used rather than to the type of activity. As a result, average expenditures per person per night have been developed for each of the four major accommodation types used throughout this study.

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* Ontario Tourism and Outdoor Recreation Planning Study Committee Tourism and Recreation Behaviour of Ontario Residents, Volume 3, p. 176. Waterfowl hunting is not reported separately but is included with other types of hunting.

** U.S. Department of the Interior U.S. National Survey of Fishing and Hunting, 1970.

*** Ontario Ministry of Natural Resources Crown Land Recreation Study Phase I, June 1977, p. 40.

a. Cottaging

Expenditures at private cottages when overnight stays are involved have been estimated in two of the studies reviewed. Cottages and Cottagers estimates trip-related expenditures at $4.69 per cottager per weekend day, and $8.33 per cottager per vacation day.* The Crown Land study contains an estimate of $5.00 in trip-related expenditures per user-day.** Based on examination of these two sources, an estimate of $7.00 per cottager per day has been made.

b. Camping

Expenditures on a per camper basis were derived in three separate reports reviewed. An estimate of $9.27 per camper-day was made in the Crown Land study.*** The 1979 Provincial Parks Camper Survey asked park users for their expenditures within 25 miles of the park. This averaged $4.27 per day, but the figure does not include the average camper's expenditures on camping permits.**** The Manitoba Visitor Expenditure Study derived an average expenditure per camper per day of $9.09.***** Once the Provincial Parks figures are adjusted to reflect camping permit expenditures and all-trip related spending, an estimate of $9.00 seems reasonable for use in this study.

c. Commercial Accommodation

Average expenditure of commercial accommodation includes a wide range of accommodation types including: hotels, motels, resorts, cottages and cabins and tourist homes. In The Fishing and Hunting Lodge Industry in Northern Ontario, expenditures per fishing occasion were estimated at $16.60 while using commercial accommodation.****** However, this average expenditure includes expenditures at commercial campsites. The Manitoba Visitor Expenditure Study estimated that visitors spent an average of $18.58 in commercial accommodation per person per day.* In Cottages and Cottagers the average expenditure per person per day at non-private cottages was $11.61 on weekends and $18.22 on vacations.** Using all three sources, an estimate of $20.00 seems reasonable. This may appear low when one considers resort and motor hotel costs per person, but it must be realized that cheaper hotels, housekeeping cabins and cottages make up the bulk of the available accommodation in the key tourist areas. The resort/lodge and motor hotel account for 18% of the total available accommodation.

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* Ontario Ministry of Natural Resources Cottages and Cottagers, June 1979, p. 72, expense per trip divided by average party size of 4.4 for weekends and 4.5 for vacation trips.

** Ontario Ministry of Natural Resources Crown Land Recreation Study Phase I, June 1977, p. 40.

*** Ibid.

**** Ontario Ministry of Natural Resources, Parks and Recreational Area Branch 1979 Provincial Parks Camper Survey.

***** Manitoba Department of Tourism, Recreation and Cultural Affairs, Manitoba Visitor Expenditure Study, 1972.

****** Ontario Ministry of Northern Affairs The Fishing and Hunting Lodge Industry in Northern Ontario, January 1979, p. 15.

	No. of Rooms***
Hotel	30%
Motor hotel	7%
Motel	19%
Resort lodge	11%
Cottage/cabin	33%
Tourist home	-%

d. Home of Friends and Relatives

There are no existing studies which provide expenditure estimates for this type of accommodation. It is, however, most similar to the expenditures associated with overnight visits to private cottages. As a result, the figure of $7.00 per person per night has also been used for this type of accommodation.

The expenditures associated with moose hunting have been treated differently. As previously discussed, this activity has been estimated on the basis of the permits as opposed to the occasions and overnight stays. In addition, the Ministry of Natural Resources estimates the value of moose hunting from annual questionnaires which they administer. Therefore, these 1978 expenditure estimates have been used and are summarized as follows to represent the situation in 1980.****

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* Manitoba Department of Tourism, Recreation and Cultural Affairs, Manitoba Visitor Expenditure Study, 1972.

** Ontario Ministry of Natural Resources Cottages and Cottagers, June 1979, p. 72, expenses per trip "at other accommodation" divided by average party size of 4.4 for weekends and 4.5 for vacation trips.

*** Estimated from an unpublished profile of 1978 accommodation for the Georgian Bay, Northeastern and Northwestern Tourist Regions as prepared by Ontario Ministry of Industry and Tourism.

**** 1978 figures provided by the Ministry of Natural Resources, Wildlife Branch, stated in June 1980 dollars.

	Resident	Non-Resident
Licence fees	$ 1,236,000	$ 1,266,000
Expenditures	25,920,000	3,787,000
Total	27,156,000	5,053,000

B. The Economic Value of Aquatic-Based Recreation and Tourism in Ontario

The economic value of aquatic-based recreation and tourism is calculated by multiplying the number of occasions for each activity and the number of overnight stays by accommodation type as estimated in Appendix II. Exhibits III-6 - III-23 summarize these calculations. In total, aquatic-based recreation and tourism is estimated to account for $750 million of direct expenditures. In addition to expenditures two additional types of economic measurement were developed: an estimate of indirect expenditures and an estimate of employment. In addition the literature was examined to determine the type of expenditures most commonly made by people on recreational and tourism trips.

1. Indirect Expenditures

In addition to the direct expenditures additional or indirect expenditures are also generated by participants in aquatic-based recreation and tourist activities. These expenditures are normally developed by use of a multiplier which is applied to the direct expenditures.

Indirect expenditures are not given in detail in this appendix. They can be calculated by multiplying the direct expenditures by the following regional multipliers:

Parry Sound, Muskoka and Haliburton	1.6
Acid-sensitive Eastern Ontario	1.6
Northeastern	1.5
Northwestern	1.4

These regional multipliers are those developed in the report The Economic Impact of Tourism in Ontario and Regions.*

2. Estimating Employment

The estimates of man-years of employment are estimated from the report the Economic and Social Importance of Ontario Tourism.** From this report, a ratio of direct tourism expenditures to direct employment man-years was developed and updated to 1980.

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* Ontario Ministry of Industry and Tourism The Economic Impact of Tourism in Ontario and Regions, p. 75.

** Larry Smith & Associates Ltd. Economic and Social Importance of Ontario Tourism, March 1978, estimated from Table 5 and Table 8 updated to reflect 1980 dollars by use of average weekly wage increase as estimated from Statistics Canada Employment, Earnings and Homes Catalogue 72-002.

The estimates of man-years of employment used in this report are based upon the following regional estimates of direct expenditures required to generate one direct local employment opportunity.

Parry Sound, Muskoka and Haliburton	$22,000	) $ of direct
Acid Sensitive Eastern Ontario	23,000	) expenditures to
Northeastern	22,000	) generate one
Northwestern	22,000	) man-year of
Ontario	23,000	) employment

These figures are divided into the total direct expenditures to estimate the number of man-years of employment generated by direct expenditures for aquatic-based recreation and tourism.

3. Type of Expenditures

Two information sources exist which provide some understanding of the types of expenditures. The 1975 Angler Survey* provides estimates for resident and non-resident anglers.

	Expenditure By Major Category % of Total	
	Resident	Non-Resident
Food	26%	23%
Travel	25	19
Accommodation	19	39
Fishing Gear	12	4
Boat Maintenace	11	6
Other	7	9

The other source is the study of the Economic and Social Importance of Ontario Tourism.** As indicated below, this study also estimates that food, travel and accommodation account for over 70% of the direct expenditures on-tourism in Ontario.

	% of Total Expenditures-Ontario
Food	26%
Travel	37
Accommodation	13
Amusement and Recreation	8
Miscellaneous	16

Thus the greatest impact of declines in aquatic-based recreation and tourism will primarily be on the food, travel and accommodation sectors of the economy.

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* Ontario Ministry of Natural Resources Angler Survey, 1975 Draft Report, Table 37, p.70.

** Ministry of Industry and Tourism - Economic and Social Importance of Ontario Tourism prepared by Larry Smith & Associates Ltd., March 1978, calculated from Table 5, p. 18.

C. Expenditures on Durables

As previously discussed, expenditures on durables are not normally included in estimates of the economic significance of recreation and tourism. Key types of these expenditures relate to automobile purchase, cottage purchase, and recreation and leisure equipment. Available information is almost non-existent in this area.* In addition, it is extremely difficult to determine the component of these expenditures that relates to aquatic-based recreation and tourism.

Of these types of expenditures, cottage and boat related expenditures are among those that will be influenced by acidification of the aquatic environment. For cottages an estimate has been made of the number of cottages (Exhibit 24). No information exists on the value of these cottages and the expenditures on items such as property taxes, utilities and major repairs. If additional research suggests that widespread aquatic acidification will reduce the desirability of cottage ownership, the magnitude of these types of expenditures will need to be examined in further detail. As Ontario has an estimated 330,000 cottages, these types of expenditures and the investment of cottage owners are substantial.

An indication of angler investment can be obtained from the 1975 Angler Survey.** This survey estimated that Ontario residents owned $232 million of fishing gear. Annual purchases on major items amounted to $454 million for major equipment used in conjunction with fishing trips. An estimated $3.9 million of these purchases was fishing equipment.

	Expenditures ($ millions)
Fishing equipment	$ 4
Boating equipment	184
Camping equipment	98
Special vehicles	146
Land - Buildings	8
Other	14
	454

With the exception of the fishing equipment, there is no means of determining what portion of these purchases are directly attributable to sports fishing. However, as with cottages it is likely that at advanced levels of aquatic acidification significant reductions in these expenditures are possible.

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* Attempts to develop this type of information include Analysis of Ontario Survey, 1968 which is based upon a limited sample and is currently 13 years old and the 1975 Angler Survey which attempts to identify the major expenditures of anglers on boats.

** Ontario Ministry of Natural Resources Angler Survey, 1975 draft pp. 30-33.

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EXHIBIT III-1

SUMMARY OF KEY SOURCES OF TOURISM AND OUTDOOR RECREATION EXPENDITURE DATA

	ANALYSIS OF ONTARIO COTTAGE SURVEY 1968	ALGOMA AREA VISITORS STUDY 1970	(U.S.) NATIONAL SURVEY OF FISHING AND HUNTING 1970
METHOD			
TIME PERIOD COVERED	1968		JANUARY 1 - DECEMBER 31, 1970
TRIP DEFINITION	COTTAGE VACATIONING	AUTOMOBILE PARTY LEAVING ALGOMA AREA	SPENT $7.50 OR MORE OR REPORTED THREE OR MORE FISHING OR HUNTING RECREATION DAYS DURING 1970
SAMPLE SIZE	1,200	1,258	24,000 HOUSEHOLDS
NUMBER OF USABLE RESPONSES	347	1,258	21,100 HOUSEHOLDS
RESIDENCE	ONTARIO COTTAGE OWNER	ALGOMA NON-RESIDENTS	UNITED STATES
TYPE OF SURVEY	MAIL OUT	PERSONAL INTERVIEW (AUTO)	INTERVIEW AND MAIL BACK
PERSONS COVERED IN THE HOUSEHOLD	HEAD OF HOUSEHOLD		PERSONS 9 YEARS AND OLDER
RECALL PERIOD	N/A	N/A	
CONDUCTED: BY/FOR	KATES, PEAT, MARWICK/ONTARIO DEPARTMENT OF TOURISM AND INFORMATION	ONTARIO DEPARTMENT OF TOURISM AND INFORMATION	U.S. DEPARTMENT OF THE INTERIOR
PER PERSON EXPENDITURE DATA			
BY OCCASION/DAY/TRIP	PER SEASON	PER TRIP/DAY	PER DAY
BY LENGTH OF STAY	N/A	OVERNIGHT VS. NON-OVERNIGHT	
BY ACCOMMODATION	N/A		
BY ACTIVITY	COTTAGING		FISHING AND HUNTING
$ BASE YEAR	1968	1970	1970
CATEGORIES INCLUDED	TAXES, MAINTENANCE, ALL OTHER EXPENDITURES ON COTTAGE VACATIONING	ACCOMMODATION, FOOD AND BEVERAGE, ENTERTAINMENT, GIFT MERCHANDISE, PERSONAL USE MERCHANDISE, OTHER	FOOD & LODGING, TRANSPORTATION, AUXILIARY EQUIPMENT, FISHING AND HUNTING EQUIPMENT, LICENSES, PRIVILEGE FEES
COMMENTS	SUMMARIZES COTTAGE SURVEY DATA IN A WIDE VARIETY OF WAYS, BASED ON SMALL SAMPLE, NOT USED DIRECTLY IN EXPENDITURE ESTIMATES	EXPENDITURES ARE THOSE IN THE ALGOMA AREA ONLY. OVERNIGHT TRIP EXPENDITURES NOT BROKEN DOWN BY TYPE OF ACCOMMODATION - NOT USED DIRECTLY	BASIS FOR ONTARIO ANGLING RESIDENTS' EXPENDITURE ESTIMATES. BIG GAME HUNTING, WATERFOWL HUNTING AND FRESHWATER FISHING ARE SEPARATE CATEGORIES. USED FOR OUR ESTIMATES IN THE ABOVE CATEGORIES.

EXHIBIT III

SUMMARY OF KEY SOURCES OF TOURISM AND OUTDOOR RECREATION EXPENDITURE DATA

	ONTARIO ANGLER SURVEY (DRAFT) 1975	B.C. VISITORS 1974 1975	MANITOBA VISITOR EXPENDITURE STUDY (1972)
METHOD			
TIME PERIOD COVERED	JANUARY 1 - DECEMBER 31, 1975	SUMMER OF 1974	MAY - SEPTEMBER 1971
TRIP DEFINITION	ANY FISHING OCCASION	A TRIP BY A NON-RESIDENT TO B.C.	VISIT TO MANITOBA TOURIST RECEPTION CENTRE
SAMPLE SIZE	RESIDENTS 5,766 NON-RESIDENTS 2,506	AUTO EXIT SURVEY 8,680 TERMINAL SURVEY 1,250	30,601
NUMBER OF USABLE RESPONSES	RESIDENTS 3,137 (1,366 FISHED IN 1975 NON-RESIDENTS 1,771	SAME	SAME
RESIDENCE	ONTARIO RESIDENTS/NON-RESIDENTS	B.C. NON-RESIDENTS (CANADIANS SHOWN SEPARATELY)	CANADA/UNITED STATES/OTHER
TYPE OF SURVEY	MAIL OUT	PERSONAL INTERVIEW	INTERVIEWS AT MANITOBA TOURIST RECEPTION CENTRES
PERSONS COVERED IN THE HOUSEHOLD	ALL MEMBERS OF THE HOUSEHOLD	ALL TRAVELLERS IN THE PARTY	ALL TRAVELLERS IN THE PARTY
RECALL PERIOD	2 RECALLS AT 3-4 WEEK INTERVALS	N/A	N/A
CONDUCTED: BY/FOR	ONTARIO MINISTRY OF NATURAL RESOURCES	B.C. RESEARCH/B.C. DEPARTMENT OF TRAVEL INDUSTRY	MANITOBA DEPARTMENT OF TOURISM RECREATION AND CULTURAL AFFAIRS
PER PERSON EXPENDITURE DATA			
BY OCCASION/DAY/TRIP	PER ACTIVE ANGLER-DAY (OCCASION)	PER DAY	AVERAGE PER DAY
BY LENGTH OF STAY	N/A	N/A	NOT ASKED
BY ACCOMMODATION	N/A	N/A	CAMPING VS. COMMERCIAL ACCOMMODATION
BY ACTIVITY	FISHING (BY LICENSE TYPE)	BUSINESS, VISITING, VACATION, ETC.	NOT ASKED
$ BASE YEAR	1975	1974	1971
CATEGORIES INCLUDED	ACCOMMODATION, FOOD & MEALS, TRAVEL WITHIN ONTARIO, FISHING GEAR, BAIT, BOAT MAINTENANCE, GUIDE SERVICES, OTHER	MEALS, GROCERIES, ACCOMMODATION, AUTO (OIL & GAS, AND MAINTENANCE) RECREATION, GIFTS, MAJOR EXPENDITURES (PROPERTY, BOAT) OTHER	ACCOMMODATION, TRANSPORTATION, ENTERTAINMENT, RESTAURANT, GROCERY, RETAIL SHOPPING, OTHER EXPENDITURES
COMMENTS	AN EXHAUSTIVE SURVEY OF ONTARIO FISHING LOW RESPONSE RATES LIMITS DETAILED BREAKDOWN OF DATA. CONSULTED IN ANGLING EXPENDITURE ESTIMATION	OVERNIGHT TRIPS WERE NOT ANALYZED BY ACCOMMODATION TYPE - NOT USED DIRECTLY IN OUR EXPENDITURE ESTIMATES	USEFUL STUDY FOR DETERMINING TRAVELLERS' OVERNIGHT TRIP. EXPENDITURES USED IN ESTIMATION OF SPENDING ON CAMPING AND COMMERCIAL ACCOMMODATION

EXHIBIT III-3

SUMMARY OF KEY SOURCES OF TOURISM AND RECREATION EXPENDITURE DATA

	SURVEY AND ANALYSIS OF (ALBERTA) RESIDENT AND NON-RESIDENT TRAVEL 1972	U.S. AUTO VISITORS TO ONTARIO 1974	THE FISHING AND HUNTING LODGE INDUSTRY IN NORTHERN ONTARIO 1979
METHOD			
TIME PERIOD COVERED	MID-JUNE - SEPTEMBER 6, 1971	JULY 1, 1973 - JUNE 30, 1974	JANUARY 1 - DECEMBER 31, 1977
TRIP DEFINITION	NON-RESIDENT VISIT TO ALBERTA RESIDENT TRIP OUTSIDE ALBERTA	PARTY IN NON-COMMERCIAL VEHICLE LEAVING PROVINCE	LAST TRIP TO NORTHERN ONTARIO IN 1977
SAMPLE SIZE	12,982 DIRECT VISITOR INTERVIEWS 6,800 DIRECT RESIDENT INTERVIEWS 4,640 MAIL BACK QUESTIONNAIRES	8,700	2,860
NUMBER OF USABLE RESPONSES	SAME	SAME	814
RESIDENCE	ALBERTA NON-RESIDENTS IN ALBERTA ALBERTA RESIDENTS OUTSIDE ALBERTA	UNITED STATES	ANYWHERE
TYPE OF SURVEY	PERSONAL INTERVIEWS AND MAIL BACK	PERSONAL INTERVIEW	MAIL OUT
PERSONS COVERED IN THE HOUSEHOLD	ALL PERSONS IN PARTY	ALL PERSONS IN PARTY	TOTAL VISITOR PARTY
RECALL PERIOD	N/A	N/A	N/A
CONDUCTED: BY/FOR	KATES, PEAT, MARWICK/TRAVEL ALBERTA	ONTARIO MINISTRY OF INDUSTRY AND TOURISM	RUSTON/SHANAHAN & ASSOCIATES/ ONTARIO MINISTRY OF NORTHERN AFFAIRS AND NOTO
PER PERSON EXPENDITURE DATA			
BY OCCASION/DAY/TRIP	PER TRIP, PER DAY	PER DAY	PER PARTY - TRIP
BY LENGTH OF STAY	DAY USE VS. OVERNIGHT	DAY VISIT VS. OVERNIGHT	
BY ACCOMMODATION			
BY ACTIVITY	VACATION, PLEASURE, BUSINESS, ETC.		
$ BASE YEAR	1971	1974	1977
CATEGORIES INCLUDED	MEALS, GROCERIES, LODGING, AUTO (OIL & GAS, MAINTENANCE), NON-AUTO TRANSPORTATION, RECREATION, ALL OTHER GOODS AND SERVICES	TRANSPORTATION, ACCOMMODATION, RESTAURANT, GROCERIES, AMUSEMENT/ RECREATION, MAJOR EXPENDITURES, OTHER PURCHASES	ACCOMMODATION, MEALS, BOAT AND EQUIPMENT RENTAL, FARES, GAS
COMMENTS	DOES NOT ANALYZE ALBERTA RESIDENTS TRAVEL EXPENDITURES IN ALBERTA - NOT USED DIRECTLY FOR OUR ESTIMATES	GOOD SURVEY OF U.S. VISITORS, BUT DOES NOT SUMMARIZE OVERNIGHT TRIP EXPENDITURES BY ACCOMMODATION TYPE	EXPENDITURES PER PERSON - DAY COULD NOT BE DERIVED FROM THE PUBLICATION, ALTHOUGH ANALYSIS OF THE QUESTIONNAIRES COULD HAVE PROVIDED THIS INFORMATION. SOME USEFUL ANALYSIS OF CROWN LAND RECREATION STUDY FIGURES.

EXHIBIT I

SUMMARY OF KEY SOURCES OF TOURISM AND OUTDOOR RECREATION EXPENDITURE DATA

	TRAVEL SURVEY OF ONTARIO HOUSEHOLDS 1976	PROVINCIAL PARKS CAMPER AND DAY USE SURVEY 1979	VACATION TRAVEL BY CANADIANS IN 1978 (1979)
METHOD			
TIME PERIOD COVERED	JANUARY 1 - DECEMBER 31, 1976	1979 PARK OPERATING SEASON	JANUARY 1 - DECEMBER 31, 1978
TRIP DEFINITION	25 MILES OR MORE	VISIT TO A PROVINCIAL PARK	VACATION TRIP
SAMPLE SIZE	57,600	15,570 CAMPER PARTIES 6,150 DAY USERS	6,554
NUMBER OF USABLE RESPONSES	15,200	7,078 CAMPER PARTIES 2,761 DAY USERS	SAME
RESIDENCE	ONTARIO	ANYWHERE	CANADA
TYPE OF SURVEY	MAIL BACK	PERSONAL DISTRIBUTION, DROP OR MAIL BACK	PERSONAL INTERVIEW
PERSONS COVERED IN THE HOUSEHOLD	ALL MEMBERS - NO AGE LIMIT	ALL PARTY MEMBER	INDIVIDUALS 18 YEARS AND OVER
RECALL PERIOD	1 MONTH		N/A
CONDUCTED: BY/FOR	ONTARIO MINISTRY OF INDUSTRY AND TOURISM	ONTARIO MINISTRY OF NATURAL RESOURCES	TRAVEL DATA INTERNATIONAL/ CANADIAN GOVERNMENT OFFICE OF TOURISM
PER PERSON EXPENDITURE DATA			
BY OCCASION/DAY/TRIP	PER DAY	PER DAY	PER VACATION DAY
BY LENGTH OF STAY	N/A	DAY-USE VS. OVERNIGHT	VACATION ONLY - DOES NOT INCLUDE WEEKENDS
BY ACCOMMODATION	N/A	CAMPING	
BY ACTIVITY	N/A	N/A	
$ BASE YEAR	1976	1979	1978
CATEGORIES INCLUDED	ACCOMMODATION, FOOD/BEVERAGE, SERVICE STATIONS, AMUSEMENT/RECREATION, RETAIL SALES/MISCELLANEOUS, PUBLIC TRANSPORTATION	ENTERTAINMENT AND ATTRACTIONS, FOOD AND DRINK, FUEL AND OTHER TRANSPORTATION, MISCELLANEOUS	VERY BROAD - 'TOTAL COST OF TRIP'
COMMENTS	GOOD TRAVEL SURVEY WITH LARGE SAMPLE NOT IN PUBLISHED FORM. SPECIFIC SURVEY RESULTS CAN BE OBTAINED FROM THE MINISTRY OF INDUSTRY AND TOURISM	EXPENDITURES INCLUDE ONLY THOSE MADE WITHIN 25 MILES OF THE PARK - USED FOR CAMPING AND OUTDOOR SWIMMING EXPENDITURE ESTIMATES	VAGUE DEFINITION OF EXPENDITURES, ON VACATIONS ONLY. EXPENDITURE INFORMATION NOT SUMMARIZED BY ACCOMMODATION TYPE - NOT USED DIRECTLY IN OUR ESTIMATES

EXHIBIT III-5

SUMMARY OF KEY SOURCES OF TOURISM AND OUTDOOR RECREATION EXPENDITURE DATA

	ONTARIO ANGLING 1975	THE VALUE OF NON-RESIDENT SPORT FISHING IN B.C. 1971	THE VALUE OF FRESHWATER SPORT FISHING IN B.C. 1971
METHOD			
TIME PERIOD COVERED	JANUARY 1 - DECEMBER 31, 1970	APRIL 1, 1968 - MARCH 31, 1969	
TRIP DEFINITION	ANY FISHING OCCASION IN ONTARIO	FISHING TRIPS TO B.C. BY NON-RESIDENT	FRESHWATER FISHING TRIP IN B.C.
SAMPLE SIZE	17,113 RESIDENTS/16,512 NON-RESIDENTS	8,814	RESIDENTS/NON-RESIDENTS 8,814
NUMBER OF USABLE RESPONSES	10,112 RESIDENTS/10,291 NON-RESIDENTS	3,320	RESIDENTS 2,577/NON RESIDENTS 3,320
RESIDENCE	ONTARIO RESIDENTS/NON-RESIDENTS	B.C. NON-RESIDENTS (CANADIAN SHOWN SEPARATELY)	B.C. RESIDENTS/NON-RESIDENTS
TYPE OF SURVEY	MAIL OUT	MAIL OUT	MAIL OUT
PERSONS COVERED IN THE HOUSEHOLD	FISHING AND HUNTING LICENSE HOLDERS	ANGLERS OVER 18	ANGLERS OVER 18
RECALL PERIOD		1 MONTH	
CONDUCTED: BY/FOR	ONTARIO MINISTRY OF NATURAL RESOURCES	B.C. FISH AND WILDLIFE DEPARTMENT	B.C. FISH AND WILDLIFE DEPARTMENT
PER PERSON EXPENDITURE DATA			
BY OCCASION/DAY/TRIP	PER ANGLER-DAY	PER ANGLER-DAY	
BY LENGTH OF STAY			
BY ACCOMMODATION			
BY ACTIVITY	FISHING	FISHING	FRESHWATER FISHING
$ BASE YEAR	1970	1968-69	RESIDENTS 1970, NON-RESIDENTS 1968-69
CATEGORIES INCLUDED	TRAVEL, FOOD & LODGING, FISHING SERVICES, ASSOCIATED EXPENSES, LICENSES AND OTHER EXPENSES	TRAVEL, FOOD & LODGING, FISHING SERVICES, ASSOCIATED EXPENSES, LICENSES AND OTHER EXPENSES	TRAVEL, FOOD & LODGING, FISHING SERVICES, ASSOCIATED EXPENSES, LICENSES AND OTHER EXPENSES
COMMENTS	GOOD SURVEY WITH LARGE SAMPLE AND WIDE VARIETY OF INFORMATION DERIVED. UNFORTUNATELY, RESIDENTS WERE NOT ASKED FOR EXPENDITURE DATA - NON-RESIDENTS WERE, CONSIDERED IN OUR ANGLER EXPENDITURE ESTIMATE	GOOD SURVEY, BUT APPLICABILITY TO ONTARIO SITUATION IS QUESTIONNABLE, SINCE IT WOULD INCLUDE SALT WATER FISHING, AND SURVEYS NON-RESIDENTS RATHER THAN RESIDENTS - NOT USED DIRECTLY	NON-RESIDENTS EXPENDITURES DRAWN FROM PRECEDING STUDY. COMPARABILITY OF B.C. RESIDENTS FISHING HABITS WITH THOSE OF ONTARIO RESIDENTS IS QUESTIONNABLE - NOT USED DIRECTLY

EXHIBIT III-6

ONTARIO
ESTIMATED EXPENDITURES ON HOME-BASED ACTIVITIES BY TYPE OF PARTICIPANT-1980

(all figures $000's)

Activity	Residents	Non-Residents				Total
		U.S.	Other Foreign	Other Cdn.	Total	
Swimming (natural environment)	$160,674	$ 835	$ 10	$ 520	$1,370	$162,044
Boating	124,665	1,880	24	1,176	3,080	127,745
Fishing	142,445	3,360	56	2,096	5,512	147,957
Waterskiing	17,028	350	10	200	560	17,588
Scuba Diving	3,695	25	-	25	50	3,745
Hunting-Waterfowl	4,406	12	-	12	24	4,430
Total	452,913	6,442	105	4,029	10,596	463,509

EXHIBIT III-7

ONTARIO
ESTIMATED EXPENDITURES ON OVERNIGHT ACTIVITIES BY TYPE OF PARTICIPANT - 1980
(ALL FIGURES 000'S)

RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	10,126	70,882	4,308	38,772	1,652	33,040	1,575	11,025	153,719
boating	6,989	48,923	1,967	17,703	1,165	23,300	306	2,142	92,068
fishing	4,528	31,696	1,930	17,370	707	14,140	389	2,723	65,929
waterskiing	1,976	13,832	258	2,322	504	10,080	30	210	26,444
scuba diving	392	2,744	44	396	86	1,720	8	56	4,916
hunting-waterfowl	86	602	2	18	4	80	12	84	784
TOTAL AQUATIC	24,097	168,679	8,509	76,581	4,118	82,360	2,320	16,240	343,860
TOTAL ALL RECREATIONAL ACTIVITIES	40,687	284,809	17,270	155,430	10,541	210,820	24,185	169,295	820,354

NON RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	508	3,556	237	2,133	809	16,180	82	574	22,443
boating	797	5,579	316	2,844	1,077	21,540	98	686	30,649
fishing	1,344	9,408	820	7,380	1,618	32,360	306	2,142	51,290
waterskiing	106	742	45	405	164	3,280	15	105	4,532
scuba diving	11	77	6	54	16	320	2	14	465
hunting-waterfowl	5	35	1	9	6	120	0	-	164
TOTAL AQUATIC	2,771	19,397	1,425	12,825	3,690	73,800	503	3,521	109,543

EXHIBIT III-8

ESTIMATE OF TOTAL EXPENDITURES BY TYPE OF PARTICIPANT-ONTARIO

1980 (all figures $000's)

	Resident			Non-resident			All Participants		
	Home Based	Over-night	Total	Home Based	Over-night	Total	Home Based	Over-night	Total
swimming (natural environment)	160674	153719	314393	1370	22443	23813	162044	176162	338206
boating	124665	92068	216733	3080	30649	33729	127745	122717	250462
fishing	142445	65929	208374	5512	51290	56802	147957	117219	265176
waterskiing	17028	26444	43472	560	4532	5092	17588	30976	48564
scuba diving	3695	4916	8611	50	465	515	3745	5381	9126
hunting-waterfowl	4406	784	5190	24	164	188	4430	948	5378
Total Aquatic	452913	343860	796773	10596	109543	120139	463509	453403	916912

EXHIBIT III-9

PARRY SOUND, MUSKOKA AND HALIBURTON
ESTIMATED EXPENDITURES ON HOME-BASED ACTIVITIES
BY TYPE OF PARTICIPANT-1980

(all figures $000's)

Activity	Residents	Non-Residents				Total
		U.S.	Other Foreign	Other Cdn.	Total	
Swimming (natural environment)	$ 9,640	$ 50	-	$ 30	$ 80	$ 9,720
Boating	9,350	144	-	96	240	9,590
Fishing	9,974	272	8	40	320	10,294
Waterskiing	948	20	-	10	30	978
Scuba Diving	1,100	25	-	25	50	1,150
Hunting-Waterfowl	878	-	-	-	-	878
Total	31,890	511	8	201	720	32,610

Note: Data may not add to provincial totals due to rounding.

EXHIBIT III-10

PARRY SOUND, MUSKOKA AND HALIBURTON
ESTIMATED EXPENDITURES ON OVERNIGHT ACTIVITIES BY TYPE OF PARTICIPANT - 1980
(ALL FIGURES 000'S)

RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	2,384	16,688	382	3,438	349	6,980	64	448	27,554
boating	2,300	16,100	311	2,799	274	5,480	35	245	24,624
fishing	910	6,370	236	2,124	166	3,320	26	182	11,996
waterskiing	614	4,298	7	63	34	680	-	-	5,041
scuba diving	36	252	16	144	6	120	-	-	516
hunting-waterfowl	62	434	1	9	-	-	-	-	443
TOTAL AQUATIC	6,306	44,142	953	8,577	829	16,580	125	875	70,174
TOTAL ALL RECREATIONAL ACTIVITIES	9,953	69,671	1,529	13,761	1685	33,700	556	3,892	121,024

NON-RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	123	861	21	189	148	2,960	2	14	4,024
boating	170	1,890	45	405	322	6,440	4	28	8,763
fishing	106	742	18	162	127	2,540	2	14	3,458
waterskiing	33	231	6	54	40	800	-	-	1,085
scuba diving	2	14	-	-	2	40	-	-	54
hunting-waterfowl	3	21	1	9	4	80	-	-	110
TOTAL AQUATIC	537	3,759	91	819	643	12,860	8	56	17,494

Note: Data may not add to provincial totals due to rounding.

EXHIBIT III-11

ESTIMATE OF TOTAL EXPENDITURES BY TYPE OF PARTICIPANT-PARRY SOUND, MUSKOKA AND HALIBURTON -1980 (all figures $000's)

	Resident			Non-resident			All Participants		
	Home Based	Over-night	Total	Home Based	Over-night	Total	Home Based	Over-night	Total
swimming (natural environment)	9640	27554	37194	80	4024	4104	9720	31578	41298
boating	9350	24624	33974	240	8763	9003	9590	33387	42977
fishing	9974	11996	21970	320	3458	3778	10294	15454	25748
waterskiing	948	5041	5989	30	1085	1115	978	6126	7104
scuba diving	1100	516	1616	50	54	104	1150	570	1720
hunting-waterfowl	878	443	1321	-	110	110	878	553	1431
Total Aquatic	31890	70174	102064	720	17494	18214	32610	87668	120278

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-12

ACID SENSITIVE EASTERN ONTARIO
ESTIMATED EXPENDITURES ON HOME-BASED ACTIVITIES
BY TYPE OF PARTICIPANT-1980

(all figures $000's)

Activity	Residents	Non-Residents				Total
		U.S.	Other Foreign	Other Cdn.	Total	
Swimming (natural environment)	$23,163	$ 120	-	$ 75	$ 195	$23,331
Boating	20,947	320	8	200	528	21,475
Fishing	24,211	568	8	232	808	25,019
Waterskiing	4,836	100	-	60	160	4,996
Scuba Diving	30	-	-	-	-	30
Hunting-Waterfowl	130	-	-	-	-	130
Total	73,290	1,108	16	567	1,691	74,981

Note: Data may not add to provincial totals due to rounding.

EXHIBIT III-13

ACID SENSITIVE EASTERN ONTARIO
ESTIMATED EXPENDITURES ON OVERNIGHT ACTIVITIES BY TYPE OF PARTICIPANT - 1980
(ALL FIGURES 000'S)

RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	1,589	11,123	340	3,060	127	2,540	65	448	17,171
boating	1,543	10,801	184	1,656	120	2,400	30	210	15,067
fishing	1,088	7,616	124	1,116	24	480	68	476	9,688
waterskiing	282	1,974	55	495	14	280	-	-	2,749
scuba diving	47	329	-	-	-	-	-	-	329
hunting-waterfowl	8	56	-	-	-	-	-	-	56
TOTAL AQUATIC	4,557	31,899	703	6,327	285	5,700	162	1,134	45,060
TOTAL ALL RECREATIONAL ACTIVITIES	6,895	48,265	1,360	12,240	701	14,020	1,910	13,370	87,895

NON-RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	107	749	19	171	65	1,300	5	35	2,255
boating	225	1,575	39	351	136	2,700	12	84	4,710
fishing	339	2,373	59	531	205	4,100	18	126	7,130
waterskiing	24	168	4	36	14	280	1	7	491
scuba diving	1	7	1	9	1	20	-	-	36
hunting-waterfowl	-	-	-	-	-	-	-	-	-
TOTAL AQUATIC	696	4,872	122	1,098	420	8,400	36	252	14,622

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-14

ESTIMATE OF TOTAL EXPENDITURES BY TYPE OF PARTICIPANT - ACID SENSITIVE EASTERN ONTARIO - 1980 (all figures $000's)

	Resident			Non-resident			All Participants		
	Home Based	Over-night	Total	Home Based	Over-night	Total	Home Based	Over-night	Total
swimming (natural environment)	23136	17171	40307	195	2255	2450	23331	19426	42757
boating	20947	15067	36014	528	4710	5238	21475	19777	41252
fishing	24211	9694	33905	808	7130	7938	25019	16824	41843
waterskiing	4836	2749	7585	160	491	651	4996	3240	8236
scuba diving	30	329	359	-	36	36	30	365	395
hunting-waterfowl	130	56	186	-	-		130	56	186
	73290	45066	118356	1691	14622	16313	74981	59688	134669

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-15

NORTHEASTERN ONTARIO
ESTIMATED EXPENDITURES ON HOME-BASED ACTIVITIES
BY TYPE OF PARTICIPANT-1980
(all figures $000's)

Activity	Residents	Non-Residents				Total
		U.S.	Other Foreign	Other Cdn.	Total	
Swimming (natural environment)	$19,602	$ 100	5	$ 65	$ 170	$19,772
Boating	13,834	208	-	128	336	14,170
Fishing	19,939	568	8	80	656	20,595
Waterskiing	2,508	50	-	30	80	2,588
Scuba Diving	90	-	-	-	-	90
Hunting-Waterfowl	43	-	-	-	-	43
Total	56,016	926	13	303	1,242	57,258

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-16

NORTHEASTERN ONTARIO
ESTIMATED EXPENDITURES ON OVERNIGHT ACTIVITIES BY TYPE OF PARTICIPANT - 1980
(ALL FIGURES 000'S)

RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	1,216	8,512	857	7,713	181	3,620	217	1,519	21,364
boating	700	4,900	644	5,796	139	2,780	80	560	14,036
fishing	607	4,249	680	6,120	114	2,280	52	364	13,013
waterskiing	311	2,177	14	126	36	720	5	35	3,058
scuba diving	167	1,169	13	117	-	-	-	-	1,286
hunting-waterfowl	4	28	-	-	4	80	4	28	136
TOTAL AQUATIC	3,005	21,035	2,208	19,872	474	9,480	358	2,506	52,893
TOTAL ALL RECREATIONAL ACTIVITIES	5,399	37,793	4,278	38,502	1,013	20,260	3,576	25,032	121,587

NON-RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	60	420	66	594	91	1,820	12	84	2,918
boating	90	630	99	891	136	2,720	19	133	4,374
fishing	139	973	154	1,386	212	4,240	29	203	6,802
waterskiing	11	77	12	108	17	340	2	14	539
scuba diving	2	14	3	27	4	80	1	7	128
hunting-waterfowl	1	7	-	-	-	-	-	-	7
TOTAL AQUATIC	303	2,121	334	3,006	460	9,200	63	441	14,768

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-17

ESTIMATE OF TOTAL EXPENDITURE BY TYPE OF PARTICIPANTS-NORTHEASTERN ONTARIO

1980 (all figures $000's)

	Resident			Non-resident			All Participants		
	Home Based	Over-night	Total	Home Based	Over-night	Total	Home Based	Over-night	Total
swimming (natural environment)	19602	21364	40966	170	2918	3088	19772	24282	44054
boating	13834	14036	27870	336	4374	4710	14170	18410	32580
fishing	19939	13015	32954	656	6802	7458	20595	19817	40412
waterskiing	2508	3058	5566	80	539	619	2588	3597	6185
scuba diving	90	1286	1376	-	128	128	90	1414	1504
hunting-waterfowl	43	136	179	-	7	7	43	143	186
Total Aquatic	56016	52895	108911	1242	14768	16010	57258	67663	124921

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-18

NORTHWESTERN ONTARIO
ESTIMATED EXPENDITURES ON HOME-BASED ACTIVITIES
BY TYPE OF PARTICIPANT-1980

(all figures $000's)

Activity	Residents	Non-Residents U.S.	Non-Residents Other Foreign	Non-Residents Other Cdn.	Non-Residents Total	Total
Swimming (natural environment)	$ 6,588	$ 35	-	$ 20	$ 55	$ 6,643
Boating	10,099	152	-	91	248	10,347
Fishing	14,246	1,112	16	1,720	2,848	17,094
Waterskiing	324	10	-	-	10	334
Scuba Diving	-	-	-	-	-	-
Hunting-Waterfowl	259	-	-	-	-	259
Total	31,516	1,309	16	1,831	3,161	34,677

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-19

NORTHWESTERN ONTARIO
ESTIMATED EXPENDITURES ON OVERNIGHT ACTIVITIES BY TYPE OF PARTICIPANT - 1980
(ALL FIGURES 000'S)

RESIDENT	ACCOMMODATION TYPE								
	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	246	1,722	196	1,764	29	580	60	420	4,486
boating	185	1,295	167	1,503	28	560	38	266	3,624
fishing	259	1,813	90	810	5	100	38	266	2,989
waterskiing	35	245	11	99	-	-	5	35	379
scuba diving	-	-	-	-	-	-	-	-	-
hunting-waterfowl	5	35	-	-	-	-	-	-	35
TOTAL AQUATIC	730	5,110	464	4,176	62	1,240	141	987	11,513
TOTAL ALL RECREATIONAL ACTIVITIES	1,093	7,651	655	5,895	232	4,640	743	5,201	23,387

NON-RESIDENT	ACCOMMODATION TYPE								
	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	15	105	12	108	16	320	5	35	568
boating	27	189	23	207	31	620	10	70	1,086
fishing	593	4,151	490	4,410	667	13,340	209	1,463	23,364
waterskiing	2	14	1	9	2	40	1	7	70
scuba diving	-	-	-	-	-	-	-	-	-
hunting-waterfowl	-	-	-	-	-	-	-	-	-
TOTAL AQUATIC	637	4,459	526	4,734	716	14,320	225	1,575	25,088

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-

ESTIMATE OF TOTAL EXPENDITURES BY TYPE OF PARTICIPANT-NORTHWESTERN ONTARIO

1980 (all figures $000's)

	Resident			Non-resident			All Participants		
	Home Based	Over-night	Total	Home Based	Over-night	TOTAL	Home Based	Over-night	Total
swimming (natural environment)	6588	4486	11074	55	568	623	6643	5054	11697
boating	10099	3624	13723	248	1086	1334	10347	4710	15057
fishing	14246	2989	17235	2848	23364	26212	17094	26353	43447
waterskiing	324	379	703	10	70	80	334	449	783
scuba diving	-	-	-	-	-	-	-	-	-
hunting-waterfowl	259	35	294	-	-	-	259	35	294
Total Aquatic	31516	11513	43029	3161	25088	28249	34677	36601	71278

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-21

REMAINDER OF ONTARIO
ESTIMATED EXPENDITURES ON HOME-BASED ACTIVITIES
BY TYPE OF PARTICIPANT-1980

(all figures $000's)

Activity	Residents	Non-Residents				Total
		U.S.	Other Foreign	Other Cdn.	Total	
Swimming (natural environment)	$101,706	$ 530	10	$ 330	$ 870	$102,576
Boating	70,435	1,056	16	656	1,728	72,163
Fishing	74,074	840	16	24	880	74,954
Waterskiing	8,412	170	10	100	280	8,692
Scuba Diving	2,475	-	-	-	-	2,475
Hunting-Waterfowl	3,096	12	-	12	24	3,120
Total	260,198	2,608	52	1,122	3,782	263,980

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-22

REMAINDER OF ONTARIO
ESTIMATED EXPENDITURES ON OVERNIGHT ACTIVITIES BY TYPE OF PARTICIPANT - 1980
(ALL FIGURES 000'S)

RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	4,690	32,830	2,533	22,797	966	19,320	1,170	8,190	83,137
boating	2,261	15,827	661	5,949	605	12,100	122	854	34,730
fishing	1,663	11,641	799	7,191	398	7,960	204	1,428	28,220
waterskiing	734	5,138	170	1,530	420	8,400	20	140	15,208
scuba diving	143	1,001	16	144	80	1,600	8	56	2,801
hunting-waterfowl	7	49	1	9	-	-	8	56	114
TOTAL AQUATIC	9,498	66,486	4,180	37,620	2,469	49,380	1,532	10,724	164,210
TOTAL ALL RECREATIONAL ACTIVITIES	17,347	121,429	9,449	85,041	6,911	138,220	17,400	121,800	466,490

NON-RESIDENT	ACCOMMODATION TYPE								
ACTIVITY	PRIVATE COTTAGE		CAMPING		OTHER COMMERCIAL		FRIENDS & RELATIVES		TOTAL $
	#	$	#	$	#	$	#	$	
swimming (natural environment)	203	1,421	119	1,071	489	9,780	58	406	12,678
boating	185	1,295	110	990	452	9,040	53	371	11,696
fishing	167	1,169	99	891	407	8,140	48	336	10,536
waterskiing	36	252	22	198	91	1,820	11	77	2,347
scuba diving	6	42	2	18	9	180	1	7	247
hunting-waterfowl	1	7	-	-	2	40	-	-	47
TOTAL AQUATIC	598	4,186	352	3,168	1,450	29,000	171	1,197	37,551

Note: Data may not add to provincial totals due to rounding.

EXHIBIT III-23

ESTIMATE OF TOTAL EXPENDITURES BY TYPE OF PARTICIPANT REMAINDER OF ONTARIO

1980 (all figures $000's)

	Resident			Non-resident			All Participants		
	Home Based	Over-night	Total	Home Based	Over-night	Total	Home Based	Over-night	Total
swimming (natural environment)	101706	83137	184843	870	12678	13548	102576	95815	198391
boating	70435	34730	105165	1728	11696	13424	72163	46426	118589
fishing	74074	28220	102294	880	10536	11416	74954	38756	113710
waterskiing	8412	15208	23620	280	2347	2627	8692	17555	26247
scuba diving	2475	2801	5276	-	247	247	2475	3048	5523
hunting-waterfowl	3096	114	3210	24	47	71	3120	161	3281
Total Aquatic	260198	164210	424408	3782	37551	41333	263980	201761	465741

Note: Data may not add to Provincial totals due to rounding.

EXHIBIT III-24

Estimated Number of Cottages - 1980

	Resident*		Non-Resident**				Total	
			U.S.		Other Canadian			
	%	#	%	#	%	#	%	#
Parry Sound	6	16632						
Muskoka	15	41580						
Haliburton	7	19404						
Sub-total	28	77616	10	4620	22	1452	25	83688
Peterborough	7	19404						
Hastings	3	8316						
Lennox-Addington	2	5544						
Frontenac	3	8316						
Renfrew	4	11088						
Acid Sensitive Eastern	19	52668	14	6468	11	726	18	59862
Nipissing	4	11088						
Algoma	3	8316						
Sudbury	4	11088						
Manitoulin	2	5544						
Timiskaming	2	5544						
Cochrane	2	5544						
Northeastern	17	47124	12	5544	16	1056	16	53724
Kenora	1	2772						
Rainy River	1	2772						
Thunder Bay	2	5544						
Northwestern	4	11088	13	6006	40	2640	6	19734
Remainder of Ontario	32	88704	51	23562	11	726	34	112992
ONTARIO TOTAL	100	277200	100	46200	100	6600	100	330000

* Estimated from a specially prepared printout from the Ontario Recreation Survey updated to 1980 by use of building permit information from Statistics Canada, 64-203.

** Currie, Coopers & Lybrand estimates based upon Ontario Ministry of Natural Resources Cottages and Cottagers and Ontario Department of Industry and Tourism Analysis of Ontario Cottage Survey.

APPENDIX IV

THE OUTLOOK FOR RECREATION AND TOURISM IN ONTARIO

APPENDIX IV

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IV. THE OUTLOOK FOR RECREATION AND TOURISM IN ONTARIO

Before the implications of acid precipitation on aquatic based recreation and tourism can be understood, it is necessary to have an understanding of past trends and the future outlook for the key aquatic based recreation activities: swimming, fishing, boating, waterfowl hunting, and other water contact recreation. Acidic precipitation is only one of many factors influencing the future outlook for recreation and tourism based on these activities. Historic trend analysis and future forecasts for tourism and recreation are generally lacking in the literature and those undertaken in the province are generally site specific. The only more comprehensive attempt was in conjunction with the Crown Land Recreation Study where alternative growth scenarios for tourism and recreation were developed.*

This appendix discusses both supply and demand factors effecting the future outlook for recreation and tourism in Ontario.

A. THE DEMAND FOR RECREATION AND TOURISM

Five factors are considered key in determining the demand for recreation and tourism in Ontario:

1. Population growth and age structure.
2. Leisure time availability.
3. Patterns of participation by activity.
4. Income available.
5. Foreign travel cost differential.

The following section briefly comments on each of these factors and its implications to future trends in aquatic related recreation activities.

1. Population Growth and Age Structure

- Virtually, all forecasts of population growth suggest only modest increases for Ontario to 2001, with increases at an annual rate of less than 1%. By 2001, Ontario population will have grown from the 1981 figure of 8,731,000 to 10,584,000 in 2001.** A similar pattern is also anticipated in neighbouring provinces and states.

  Although this is significant to the outlook for aquatic related recreation and tourism activities, a far more significant factor will be the aging of the population. Over the next twenty years, the population under 34 will actually decline in numbers.

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* Ontario Ministry of Natural Resources Crown Land Recreation Study - Phase 2 prepared by Hough, Stansburry & Associates Limited, March, 1979.

** Ontario Ministry of Treasury and Economics Central Statistical Services, assumes low fertility and 30,000 net external migration per annum.

EXHIBIT IV-1

PARTICIPATION RATES DECLINE WITH AGE

% OF POPULATION PARTICIPATING

	12 to 19	20 to 34	35 to 49	50 to 64	65 and Over
Swimming	92%	80%	65%	66%	17%
Motor boating	41	39	33	26	12%
Fishing	50	42	38	28	17
Water-skiing	21	15	6	2	1
Scuba Diving	6	4	2	1	-
Waterfowl Hunting	4	5	4	2	2

Source: Ontario Recreation Survey Demographics Volume 2, p. 176, average of figures for male and female.

EXHIBIT IV-2

CHANGING POPULATION AGE STRUCTURE COMBINED WITH SLOW POPULATION GROWTH WILL RESULT IN MODEST GROWTH FOR MOST ACTIVITIES

	2001 Index of Participation 1981=100
Swimming	117
Motor boating	118
Fishing	119
Water-skiing	101
Scuba Diving	101
Waterfowl Hunting	133

	1981	2001	Change
0-11	1,562	1,372	-190
12-19	1,146	950	-196
20-34	2,331	2,134	-197
35-49	1,560	2,600	1,040
50-64	1,268	1,791	523
65+	865	1,737	872
	8,732	10,584	1,852

This is significant for aquatic related recreation and tourism. All of these activities have participation rates that decline steadily with age, Exhibit IV-1. When the population forecast and age specific participation rates are combined, a modest rate of growth of participation is anticipated from these factors. Waterfowl hunting is the exception as the participation rate increases between the 12-19 and 20-34 age groupings. Exhibit IV-2. Beyond the year 2001, the changing age structure will have a more significant impact on participation in these activities.

A number of observers feel that the "baby boom" was the key factor contributing to the rapid growth that occured in participation in many of the aquatic based activities during the 1950's and 1960's. Many of the optimistic outlooks for rapid growth for tourism and recreation in Ontario prepared during the late 1960's and early 1970's failed to recognize this trend and as a result their projections of continued rapid growth are unlikely to be realized.

2. Leisure Time Availability

In the Ontario Recreation Survey, lack of time clearly emerges as the dominate constraint to more participation in aquatic based activities. However, at present there is little evidence to suggest that more leisure time for these activities is likely to develop.

The length of the work week has not declined overall since the late 1940's. Forecasts of modest economic growth and the increasingly internationalization of industry and commerce and, thus, the requirement that the Ontario economy becomes more competitive suggests that significant reductions in working hours are likely in the near future.

Flextime and the move toward slightly longer paid vacations may result in some increase. But the emerging pattern seems to be that increases in vacation time do not increase the traditional summer vacation period, but instead result in a splitting of holiday time. The greater number of childless couples who are not restricted by the school year calendar in these vacation patterns is also contributing to this pattern.

A special analysis of the Canadian Government Travel Office survey of vacation travel by Canadians indicates that over the last ten years, the proportion of Canadians taking a vacation trip has remained in the 55-59% range with no clear trend toward an increase or decrease.*

3. Patterns of Participation by Activity

Trend data does not exist for participation rates in aquatic activities. Availability studies are based on small samples, cover short periods and generally are not conclusive concerning the growth or decline in participation in aquatic activities.

The Ontario Recreation Survey also suggests that few of the aquatic based activities have unfilled demands. Non-participants have little interest except in waterskiing, scuba diving and sailing.** This further suggests that rapid growth in participation in fishing and swimming is not likely.

American information on participation suggests that of the aquatic activities, only boating is among the ten fastest growing activities.

	Growth in Total Participation 1973-76***
Tennis	45
Snowskiing	42
Jogging	31
Snowmobiling	19
Basketball	17
Bowling	16
Bicycling	14
Pool	9
Boating	8
Camping	7

4. Income Availability

Participation in major aquatic based activities generally increases with income.**** Currently many forecasts suggest that more modest income growth should be expected in the future. Income growth is thus not expected to contribute towards rapid future increase in these activities.

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* Estimated from a special tabulation of the annual surveys of Vacation Travel by Canadians prepared for this study by the Leisure Studies Data Bank University of Waterloo.

** Ontario Recreation Survey Preference & Constraints, Volume 5, March, 1978, p. 9.

*** United States Department of Commerce The Growth of Selected Leisure Industries, May, 1979.

**** Ontario Recreation Survey Demographics Volume 2, 1978.

Another important aspect of income availability are trends in energy costs since a very large component of the expenditures for recreation and tourism in Ontario involves travel costs. Rapid increases in energy costs may result in some reduced travel. Current research suggests that consumers are likely to shift to smaller cars and reduce somewhat their automobile travel. Increased costs of gasoline are anticipated to be extremely negative for the outlook for motor boating, and waterskiing.

5. Foreign Travel Cost Differential

Relative foreign vacation costs are often a key factor contributing to non-resident visits. Current evidence suggests that this factor also impacts on the number of Canadians that vacation outside of Canada.

Currently, the Canadian dollar is at its lowest point in relation to the U.S. dollar since the thirties. In spite of this, the number of U.S. visitors has continued at low levels.

	Average Noon* Canadian Dollar	Number of Visitors 000's** U.S. to Ontario	Ontario to U.S.
1975	1.017	22,376	13,476
1976	0.986	20,755	14,706
1977	1.064	20,699	15,382
1978	1.140	20,632	15,593
1979	1.172	20,879	14,871

However, other foreign travel may have been positively influenced by the weakness in the Canadian dollar.

Average Canadian Dollar Per Unit*

	French Franc	German Mark	Japanese Yen	Total Other Foreign** Visitors (000's)
1975	.238	.414	.0034	732
1976	.207	.392	.0033	885
1977	.217	.459	.0040	801
1978	.254	.569	.0055	943
1979	.275	.639	.0054	1,161

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* Statistics Canada Canadian Statistical Review, various issues.
** Statistics Canada Travel Between Canada and Other Countries 66-001.

Although predicting trends in currency movements is extremely complex, further steep declines in the Canadian dollar relative to the American dollar and other currencies are unlikely. Thus, the outlook for large increases in tourism resulting from competitive advantages created by declining currency levels is remote. Thus future currency changes, strengthening the Canadian dollar against other currencies, are more likely to encourage Canadians to take vacations outside the country.

B. THREE SUPPLY FACTORS ARE ALSO FAIRLY NEGATIVE

Three factors on the supply side also suggest that rapid growth in recreation and tourism will not occur. These include:

- Fishing and hunting opportunities.
- The supply of cottage land.
- Trends in the resort and lodge industry.

1. Fishing and Hunting Opportunities

The status of fish supply for sport fishing in Ontario is well documented.* As has been discussed elsewhere in this report, the supply of fish is an extremely important attraction for foreign visitors and residents. At present in all road accessible areas of the province the supply of opportunities is exceeded by use. As a result, overharvesting is occurring with the result that the quality of the fishing experience is declining. Without an increase in the management of the resource, particularly increased stocking, and changes in catch limits, a reduction in activity is anticipated. Resort owners in Northern Ontario are particularly concerned about this problem.** The catch per unit function developed elsewhere in this study clearly exhibits a pattern of declining effort with a decline in the quality of the fishing resource.

A similar situation exists with the moose population. Overharvesting in road accessible locations is occurring and the moose populations are declining.*** In order to reverse this situation, the Ministry of Natural Resources is embarking on a program of more restrictive harvest and which will require non-residents to use the facilities of a resort and to hire a guide. Thus, rapid growth in the number of participants is not likely to occur although the value of the expenditures relating to moose hunting could grow.

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* Ontario Ministry of Natural Resources Crown Land Recreation Study, prepared by Hough, Stansburry & Associates Limited.

** Liddle, G. The Fishing Lodge Industry of Northern Ontario, A Perception Study of Lodge Owner Concerns, May, 1980.

*** Ontario Ministry of Natural Resources Moose Management in Ontario, May, 1980.

The situation with waterfowl is not known as no surveys exist of the population of key recreational hunting species.

2. Cottage Land

Cottages are the bases for the largest portion of aquatic based overnight recreation activity. They account for over 60% of the overnight stays associated with aquatic activities in the province. A large portion of the home based occasions also occur through this sector as many day trips are taken to cottages of family and friends. There is a possibility that the demand for cottages will increase as a result of a greater proportion of the population moving into the key cottage purchase age group.

In the future the lack of waterfront property, adjacent to major urban centres that can meet environment and other planning criteria is limited. This will hinder major growth in the number of cottages and thus aquatic based recreation activities through this sector. Current levels of construction suggest that the stock of new cottages is not being added to at a rapid rate.*

3. Resort and Lodge Industry

Those familiar with the industry, report that a significant decline has occurred in the number of establishments providing access to Ontario's aquatic resources, although good data to document this trend are not available. The rapid growth in the number of cottages during the 1950-60's and the increased popularity of camping have contributed to this decline. However, the key factor seems to be the lack of opportunities for all these establishments to become four season operations. Guests increasingly want high quality facilities. Without a long operating season it is not possible for most operators to meet these requirements. In addition, the attractions in most areas are summer oriented with opportunities for winter operations severely limited.

The outlook for future participation in outdoor recreation and tourism is mixed. Some factors suggest declines others show growth. Thus the most likely outlook in general is for a continuation of current levels of activity with the possibility of slight declines in some sectors. Of the activities of greatest effect from acidification - the outlook for fishing is among the most negative. The resource currently cannot sustain itself with current fishing pressure. Acidic precipitation will provide additional stress to this outlook.

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* Statistics Canada Building Permits 64-203 various issues.

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APPENDIX V

CALCULATING THE EFFECTS OF ACIDIFICATION ON FISHING

APPENDIX V

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V. CALCULATING THE EFFECTS OF ACIDIFICATION ON FISHING

Field and laboratory investigations have shown that acidic precipitation limits productivity and can be fatal to fish. In order to understand the effect this would have on fishing activity, a method was developed to relate the loss of fish to a loss of recreational fishing opportunities. This appendix explains the method used and the correlations developed which allow an assessment of this loss.

Limitations in the current understanding of the effects of acidification, along with limitations in the existing data, have required that a number of hypotheses be made to complete this analysis. The hypotheses are based on the best available information.

The loss of recreational value is calculated by first quantifying potential losses in fish productivity for the lakes in a geographic area, then correlating the productivity losses to losses in fishing opportunities and finally, evaluating the loss of fishing opportunities in terms of recreational occasions. This approach is depicted in Exhibit V-1. A detailed description of each of the steps in this analysis follows.

A. DEVELOP ESTIMATES OF POTENTIAL LOSS IN FISH PRODUCTIVITY

To estimate potential losses in fish productivity, it is necessary first to classify water bodies by susceptibility to acidification and secondly, to determine fish losses as they relate to lake susceptibility categories.

An inventory of Ontario lakes by pH does not exist. However, the Ministry of the Environment has classified Ontario lakes by susceptibility to acidification.* Five categories are used: I) acidified lakes, II) extremely sensitive lakes, III) moderately sensitive lakes, IV) low sensitive lakes, and V) not sensitive lakes. These classifications are based on the buffering capacity of the lake which is measured by the total inflection point alkalinity (TIA) method. This is a measure of the acid neutralizing capacity of calcium carbonate on an aquatic ecosystem, and is measured in micro equivalents per liter (1 mg $CaCO_3/l$ = 20 ueq/l). The Toxicology and Limnology Section compiled this buffering capacity data, including an "A" list of recent determinations using the improved TIA method and a "B" list of earlier data considered to be sufficiently accurate (in high alkalinity situations).**

The next step is to relate those classifications to expected losses of fish populations. The best understood relationship of loss in fish productivity is the relationship of fish reproductive failure at pH

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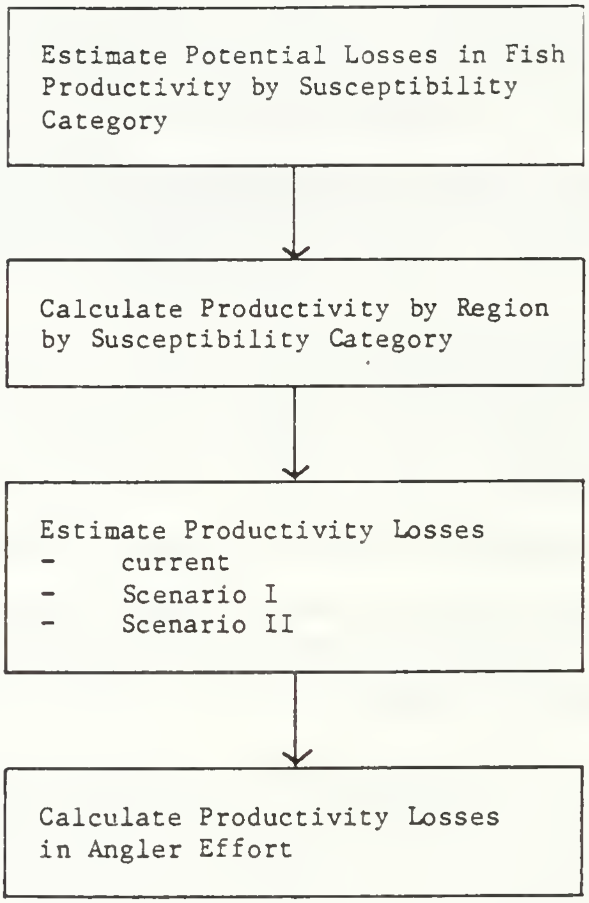
* Ontario Ministry of the Environment Acid Sensitivity Survey of Lakes in Ontario, Toronto, M.O.E. March, 1981.

** Ibid. p.i.

EXHIBIT V-1

METHOD FOR ESTIMATING REDUCTIONS IN ANGLING EFFORT


Estimate Potential Losses in Fish Productivity by Susceptibility Category
Calculate Productivity by Region by Susceptibility Category
Estimate Productivity Losses
- current
- Scenario I
- Scenario II
Calculate Productivity Losses in Angler Effort

levels below 6.0 (Beamish, 1976). The TIA measurement correlates to the pH measurement in ranges above 6.7. Below this level there is not sufficient correlation between these values to estimate pH from a TIA value (Exhibit V-2).* This is a critical data weakness in calculating the changes in fish reproduction as a result of acidification. As a result, we have made assumptions based on the Ministry of Environment TIA lake susceptibility classification.

Category I lakes (acidified) are assumed not to sustain fish reproduction. These lakes could be described as "acid dead". They may, however, still have remnant fish populations living in them. Adult fish may survive 15 to 20 years in acidified lakes (Harvey, 1980). Consequently, it is the reproduction failure which eventually causes the population losses and the loss of fish available to support recreational activities.

The Category II lakes in the extremely sensitive range include a number of lakes with pH below 6.0; consequently, there will be some partial loss of production for various target sport species. Based upon a survey of Category II lakes primarily in Muskoka and Haliburton, a distribution of pH levels has been developed (Exhibit V-3). Based on this distribution, the partial productivity losses in category II lakes due to acidification were estimated. Segments of the distribution curve below pH 6.0 were divided into pH intervals of 0.5 units. Integrating the area of each segment, the percentage distribution of lakes by pH was determined. Concurrently, for the same lakes, the productivity versus the pH was regressed, assuming a linear decline in productivity from 100% at pH 6.0 to 0% at pH 4.5. From this relationship, a productivity level was determined for each 0.5 pH segment. The resultant partial productivity of Category II lakes was estimated to be 21.5%, and a rounded figure of 20% was used for the analysis.

Some argument has been made for the use of an exponential loss curve in estimating pollution damages. This concept is argued by Crocker (1980) based upon earlier work by Butler, et al. (1973) which compared species diversity to pH. Butler's finding showed that in Pennsylvania streams the number of species declines from 116 at a pH of 6.5 to 47 at 6.4, while subsequent pH declines correspond to a more gradual loss in species. The loss rate appeared to be exponential. Such biological patterns frequently repeat themselves; however, it was not felt this provided sufficient evidence for assuming that total productivity declines were also exponential. Loss of a species can result in increased production from some competitor species, thus producing a shift in species composition while maintaining overall productivity levels. Ecosystem interrelations in a multi-species fishery are

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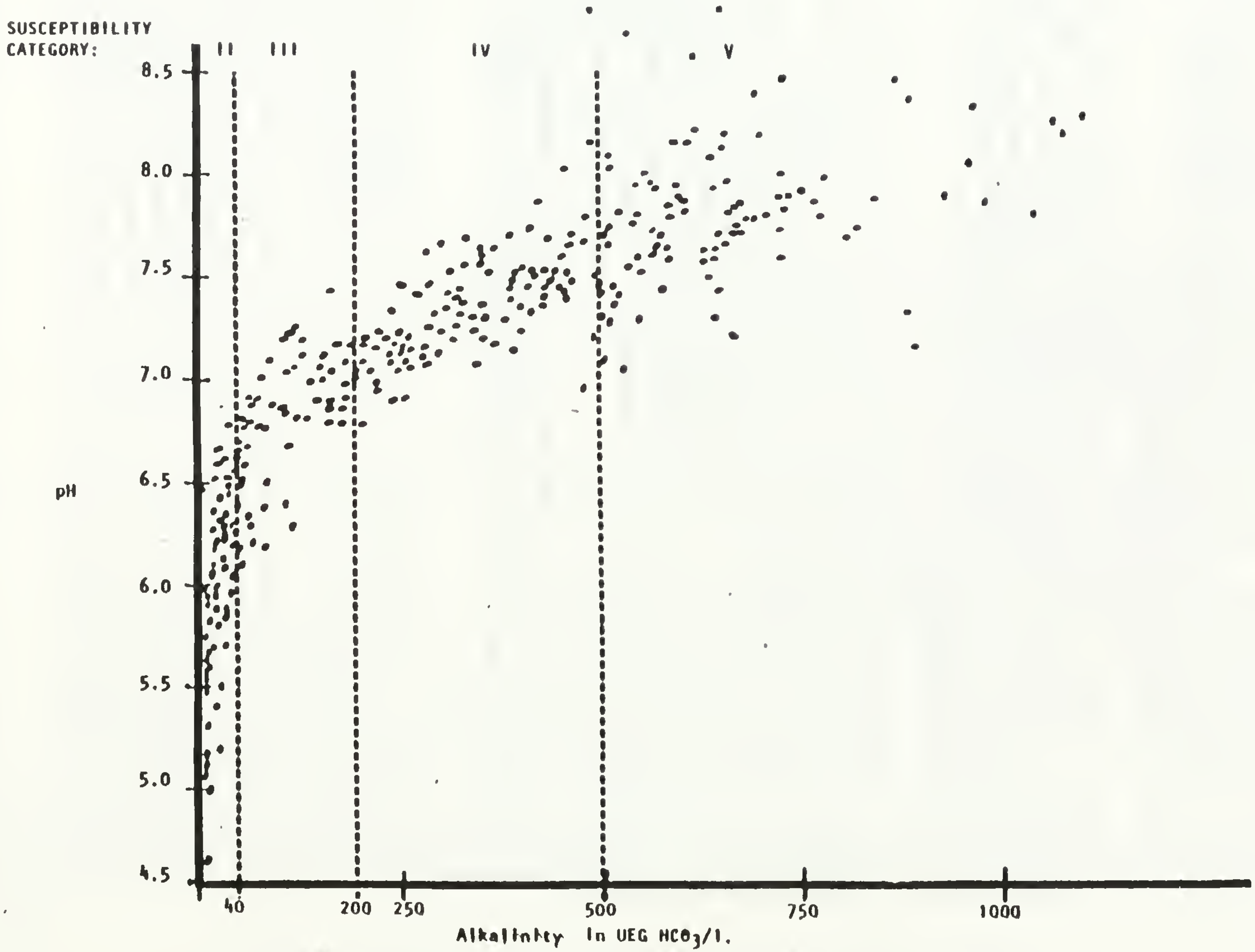
* State of Wisconsin, Department of Natural Resources Acid Deposition Task Force A Review of Acid Deposition in Wisconsin - Recommendations for Studying and Solving the Problem, 1980.

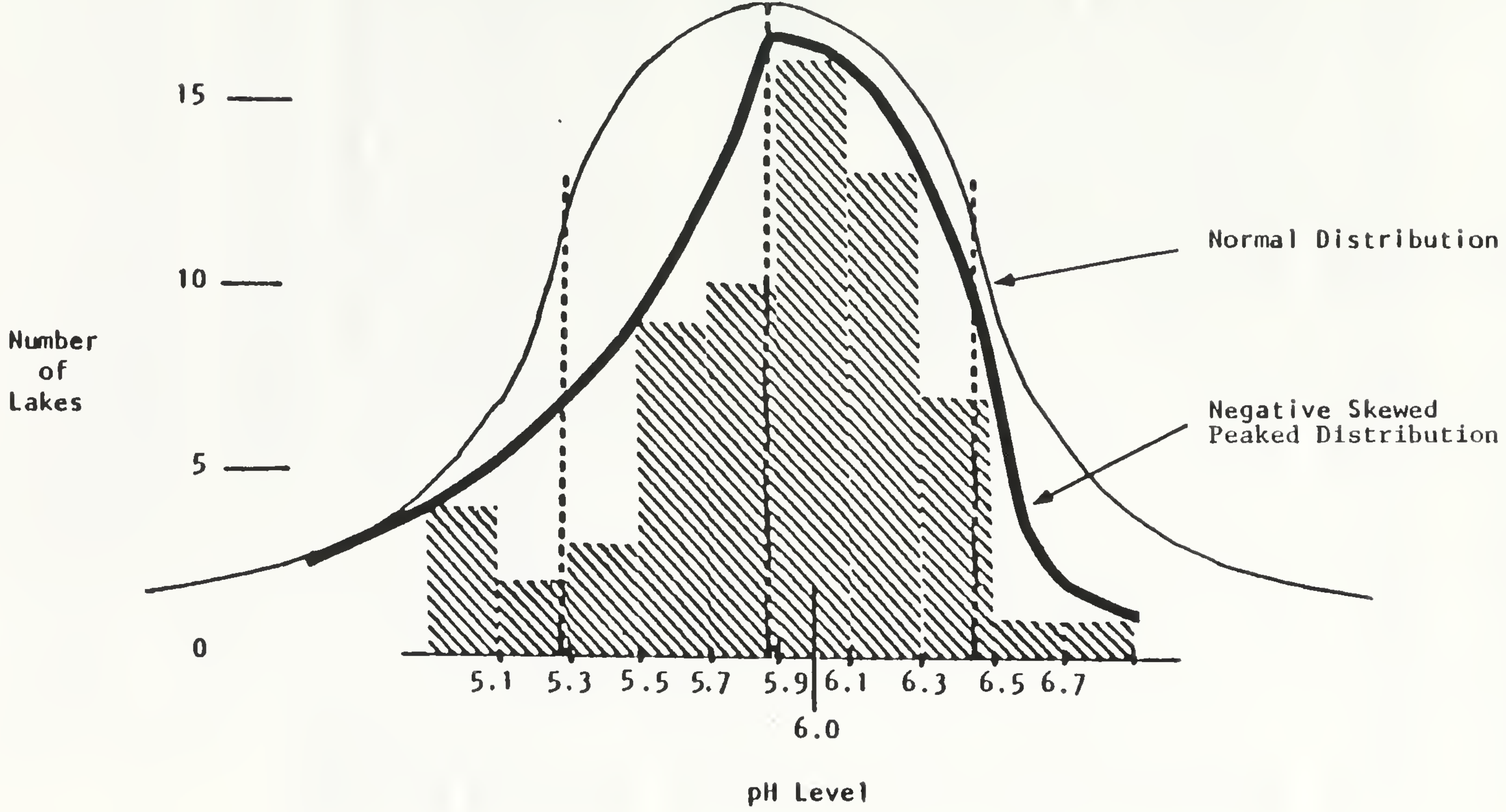
EXHIBIT V-2



COMPARISON OF pH VERSUS ALKALINITY FOR 350 NORTHERN WISCONSIN LAKES IN 1979.

Source: calculated by Earl, R. Combs Inc. from data supplied by the United States Environment Protection Agency - Lake Survey - North Central District Monitoring Program

EXHIBIT V-3



pH Distribution of Category II Lakes (Calculated from MNR Summer Lake Survey, Central Ontario, 1980) discussed in detail by May, et al. (1979). This paper emphasizes that interactions throughout the food web are extremely complex, probably not conforming to any simplistic pattern.

Furthermore, a linear relationship in the number of fish species vs. pH was observed in the La Cloche Mountain Lakes of Ontario by Harvey (1975). Consequently, for the purpose of this analysis, a conservative (linear) rate of decline was assumed.

Lakes in Categories III to V were assumed to have no losses. This productivity loss estimate makes no allowance for losses due to the acid pulse or spring thaw situation where the pH drops temporarily (Exhibit V-4) in a lake causing fish kills due to physiological shock. Juvenile fish populations are especially sensitive to this effect. The severity of acid pulse appears to be increased as watershed area increases. The cause appears to be the spring melt water which greatly dilutes the lake buffering capacity. It is this dilution of buffering capacity, in addition to the increased acid input, which creates the temporary pH drop. Consequently, it appears that lakes in the low buffered range such as Category II lakes will suffer less loss of fish productivity in this manner than will better buffered lakes. Currently, we have no way to quantify those losses.

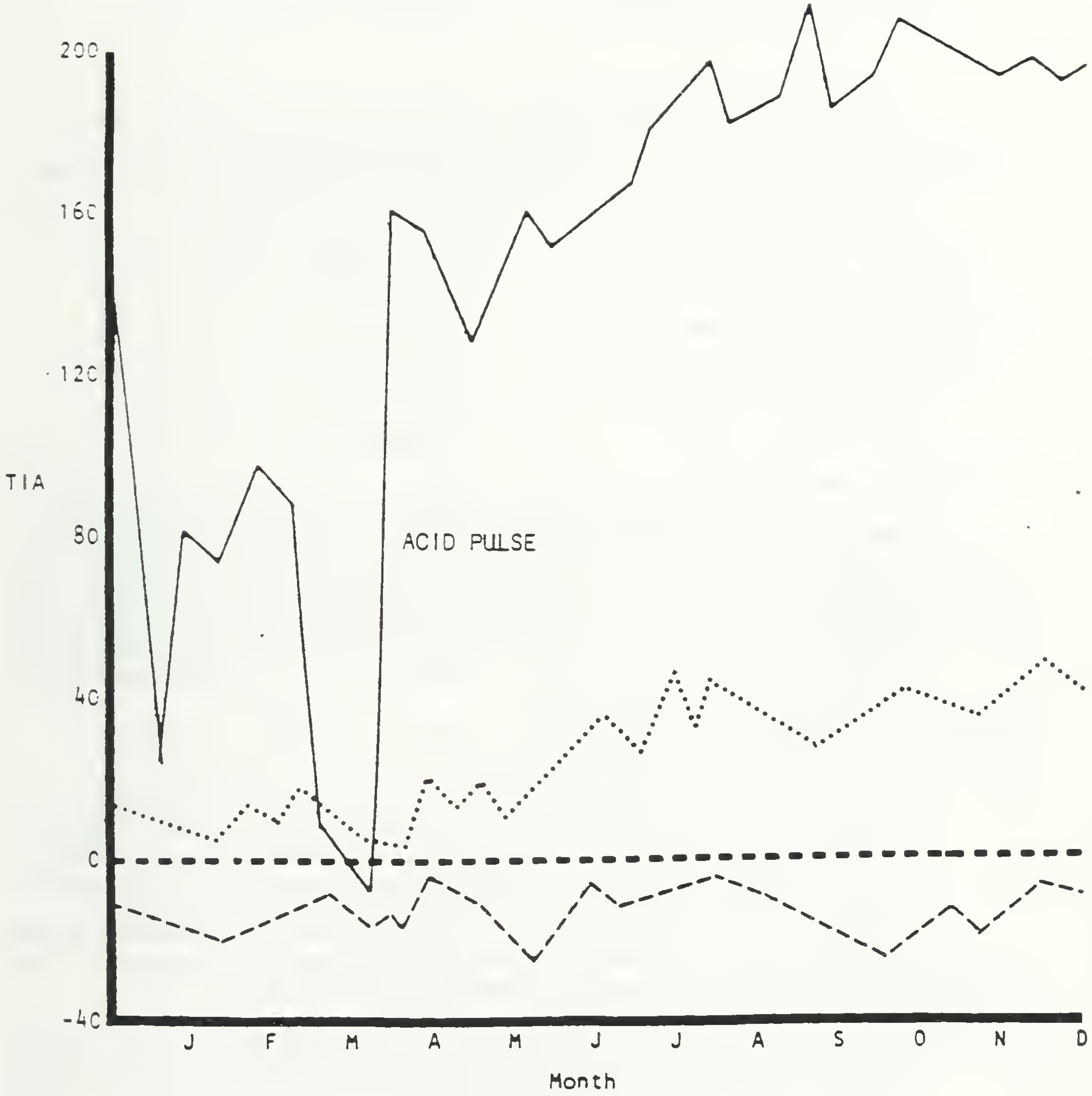
B. CALCULATING ESTIMATES OF PRODUCTIVITY

The available information requires a two-step approach to estimate the ability of a susceptible area to produce fish. First, productivity is calculated and then productivity is allocated to susceptibility categories.

The first step is to calculate the theoretical productivity for three large regions in the province: Northwestern, Northeastern and the area consisting of Parry Sound, Muskoka, Haliburton and the rest of acid sensitive Southern Ontario. Estimates of productivity have recently been developed in Ontario Fish Yield Estimates a report developed by Working Group Number Four of the Strategic Planning for Ontario Fisheries. This document provides theoretical productivity estimates for five fish yield zones. Four of these zones are in acid sensitive Ontario. In order to allocate this productivity into the regions for which user data is available the following procedure was followed.

- using Counts and Measures of Ontario Lakes, 1978 (MNR) the lake area of each of the three major regions was calculated by watersheds
- for each of the three major regions the lake area by watershed were then allocated to one of the four fish yield zones and the proportion of the total lake area within the fish yield zone was calculated

EXHIBIT V-4



Annual Variation in TIA for Three Lakes
(Based on Galloway, et.al., 1980)

- finally the productivity as calculated by SPOF, Working Group No. 4 was allocated to the three major regions based upon the proportion of lake area of the fish yield zone

One final modification was made to the resultant estimates of productivity as calculated from the estimates of the Strategic Planning for Ontario Fisheries (SPOF) Working Group No. 4 - the McCombie factor of 0.75 was applied. Exhibit V-5 summarizes these calculations. By major region, the total productivity is 18,153,000* million kg annually:

Northwestern Ontario	13,810,000 kilograms
Northeastern Ontario	3,340,000
Acid-sensitive Southern	1,003,000
	18,153,000

The second step is to allocate this theoretical productivity for these three regions to susceptibility categories. This was accomplished based upon the sample of approximately 1,500 lakes which have been classified using the total inflection point alkalinity method. It is possible to aggregate these sample productivity data by susceptibility category at the county or district level (Exhibit V-6). This sample productivity data are then grossed up to represent the entire area using the relationship that the sample bears to the total productivity of the three large regions.**

C. ESTIMATING PRODUCTIVITY LOSSES

The next step in the analysis is to estimate losses in fish productivity with acidification. The key concern of this analysis was to determine the current impact of acidic precipitation on fish. However, as the effects of acidification are expected to worsen with time, two scenarios of future shifts in the lake sensitivity categories have been created. The first scenario estimates a likely eventuality if present conditions of acid deposition continue. The second scenario estimates a "worst case" consideration.

For the current situation and each of the two scenarios, the loss in fish productivity as a result of acidification is calculated for each county or district in the acid sensitive portions of the province. Category I lakes are assumed to have total losses of productivity and potential fishing effort. Even though larger adult fish will continue to survive, reproduction has ceased which will eventually result in total loss. Category II lakes are assumed to have a 20% loss in productivity.

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* The Great Lakes are excluded from this estimate.

** The factors used for each of the county or district sample are: Northwestern, 22.32; Northeastern, 8.67; and Muskoka, Haliburton, Parry Sound and remainder of acid-sensitive Ontario, 1.85.

To determine current losses, it was assumed that those lakes, currently in Category I, previously (i.e., base line, prior to the effects of acidic precipitation) at least supported the productivity of a Category II lake. The base is an attempt to estimate the natural state, and is derived by shifting current productivity by each susceptibility category, one susceptibility category away from the Category I classification. This assumption is based upon judgement. Consequently, 80% of the maximum productivity of lakes currently in Category I would be included in current losses. In addition, the lakes currently in Category II were assumed to be formerly in Category III; hence, 20% of their theoretical productivity is lost under current conditions. In the Exhibits V-7 - V-12, the base case represents the assumed situation prior to the effects of acidic precipitation.

Scenario I represents a condition whereby acid deposition continues at some undefined rate. This condition is estimated to be an interim condition describing something less than complete loss. Under Scenario I, it is assumed that those lakes which are now in Category II will change to Category I, and those in Category III will change to Category II. Category I lakes stay the same. Losses are summed as if the Category I lakes lose 100% and Category II lakes lose 20% of their potential.

Scenario II represents a worst case condition. Category IV lakes are assumed to change to Category II and Category II are assumed to change to Category I. Category I remains the same. Losses are summed as for Scenario I.

It is recognized that there can be losses due to the acid pulse effect, but no estimate of those losses was included for this analysis.

Exhibits V-7 through V-12, show the results of these calculations. Current losses total about 168,000 kilograms, with 153,000 kilograms in the Northeast. Scenario I losses are about four times the current level at 735,000 kilograms. The worst case losses are 3.6 million kilograms occurring predominantly in the Northwestern Region.

D. ESTIMATING CHANGES IN FISHING EFFORT

The changes in current productivity for each scenario need to be equated to changes in angler effort. In order to make this estimate, it is necessary to assume that there is a relationship between angler effort and the potential harvest or productivity (measured as a catch per unit of effort - CUE). Thus, when potential harvest or productivity is reduced, a decline in effort results. This is based upon a relationship between harvest and effort represented by a CUE function.

A function relating harvest data to effort data for various regions of Ontario, would provide a description of fishing which could be used to estimate the appropriate success rate values (CUE's) for the specific levels of productivity determined from the analysis. To develop such a relationship, the data generated by McCombie was used. The study was conducted by Dr. Alan McCombie of the Ministry of Natural Resources and was part of the Lake Shore Capacity Study undertaken by the Ontario Ministry of Housing.* McCombie's work included a well-controlled sample conducted over the years 1975-78. These data describe the harvest in kg per hectare (ha) and also the hours for angling per hectare for a number of lakes in the Muskoka and Haliburton regions. Additional data on harvest and effort obtained from MNR regional biologists was also evaluated.

Based upon the McCombie data a number of regression equations were developed which relate harvest as measured in kilograms per hectare to effort measured in angling hours per hectare. The equations developed represent the harvest versus effort relationship. These equations are used to determine effort and CUE values when the harvest as measured by average MSY productivity is known.

The data from Muskoka only were used to evaluate losses in that area. Haliburton losses were likewise estimated from the curve generated from Haliburton data only. For Parry Sound and the remainder of acid-sensitive Southern Ontario lakes, the combined Muskoka/Haliburton data were used. The equations generated are shown in Exhibits V-7 - V-10. The fit of a multi-variant function to data is measured by the R^2 value. An R^2 value of 0.5 would indicate that the function accounted for about 50% of the correlation. The R^2 values for the Muskoka equation and the Haliburton equation were 0.7570 and 0.7196, respectively. Combining these data reduced the R^2 value to 0.6777. While the combined equation had a lower R^2 value, it was considered to be more generally applicable since it incorporated more data points. Muskoka data included twenty lakes; Haliburton data included 22 lakes.

To utilize these equations, an average MSY productivity rate or harvest was determined for each county or district. This value was calculated from the sample of lakes, by susceptibility category, by dividing the sample lake productivity by the sample lake area. Using the equation developed from the McCombie data, angler effort was calculated. Once calculated, the CUE was determined by dividing the average MSY productivity (harvest) by the effort in hours per hectare. The resultant CUE was used to calculate total losses, in angler hours, by dividing the CUE into the estimates of total productivity loss to determine the loss in angler effort. The partial losses (i.e., Category II lakes) were determined by calculating 80% of the MSY productivity and, using the harvest vs. effort function, the

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* McCombie A.M., Net Productivity As An Index of Cottager Impact on Fisheries. Ontario Ministry of Natural Resources, part of the Lakeshore Capacity Study, Phase III (draft).

EXHIBIT V-5

ANNUAL PRODUCTIVITY ESTIMATES BY MAJOR REGION BY SPOF FISH YIELD ZONES*

(000's kgs)

FISH YIELD ZONE	NORTHWESTERN	NORTHEASTERN	MUSKOKA, HALIBURTON, PARRY SOUND, REMAINDER OF ACID SENSITIVE
Winnipeg-Nelson Watershed	5,714	-	-
Southern James - Hudson Bay	6,093	910	-
Hudson Bay Lowlands	-	159	-
Northern Great Lakes - St. Lawrence	2,006	2,270	1,003
Total	13,813	3,339	1,003

* estimated from Working Group Number Four of the Strategic Planning for Ontario Fisheries _Ontario Fish Yield Estimates_ and the Ministry of Natural Resources _Counts and Measures of Ontario Lakes, 1978_

EXHIBIT V-6

SAMPLED LAKE PRODUCTIVITY BY COUNTY OR DISTRICT*

Area	SUSCEPTIBILITY CATEGORY					Total
	I	II	III	IV	V	
Muskoka	0	18,879 26.3%	45,730 63.7%	142 0.2%	7,017 9.8%	71,768
Haliburton	0	5,998 10.4%	23,905 41.6%	22,132 38.5%	5,453 9.5%	57,488
Parry Sound	610 .9%	8,447 12.3%	55,557 80.9%	1,772 2.6%	2,245 3.3%	68,631
Sub-total	610 0.3%	33,324 16.8%	125,192 63.3%	24,046 12.2%	14,715 7.4%	197,887
Acid Sensitive Eastern	0	170 0.1%	39,917 11.6%	17,625 5.1%	286,448 83.2%	344,160
Algoma	2,328 1.4%	1,947 1.2%	9,055 5.6%	4,696 2.9%	144,023 88.9%	162,049
Cochrane	0	18 .1%	0	63 .2%	33,068 99.7%	33,149
Manitoulin	4,759 10.0%	212 .4%	0	57 .1%	42,471 89.5%	47,499
Nipissing	0	619 1.0%	57,896 92.7%	3,942 6.3%	0	62,457
Sudbury	12,715 23.0%	5,669 10.3%	8,528 15.4%	8,872 16.1%	19,447 35.2%	55,231
Timiskaming	167 0.8%	0	0	15,417 62.1%	9,258 37.2%	24,842
Northeastern	19,969 5.2%	8,465 2.2%	75,479 19.6%	33,047 8.6%	248,267 64.4%	385,227
Kenora	0	0	2,441 0.8%	136,276 45.6%	160,343 53.6%	299,060
Rainy River	0	0	42,470 47.5%	17,680 19.8%	29,227 32.7%	89,377
Thunder Bay	0	255 0.1%	6,063 2.6%	98,886 42.9%	125,092 54.4%	230,296
Northwestern	0	255 -%	50,974 8.2%	252,842 40.9%	314,662 50.9%	618,733

* Based upon sample of about 1,500 lakes

corresponding effort and CUE are calculated. The loss in angler effort in hours is then calculated by determining the difference between effort at full productivity and effort at 80% productivity, using the reduced CUE.

The Northeastern and Northwestern Regions were evaluated in a simplified manner, as harvest vs. effort functions were not developed. Consequently, a single point catch per unit effort rate is used for each region.

Available CUE data from 26 lake trout lakes in the Northeast resulted in a mean of 0.15 kg/hr. Warm water lakes in the Northeast averaged 0.26 kg/hr.* Unfortunately, the productivity could not be divided between these two lake types, so a simple average of 0.20 kg/hr was selected for the Northeast Region.

A value of 0.25 kg/ha was used for the Northwest Region evaluation. The success rate was considered by MNR biologists to be typical for the area. It is comparable to the success rate of Leech Lake in Northern Minnesota.**

A detailed sample calculation using Haliburton has been included as Exhibit V-14.

From the relationships established above, the losses in angler effort hours were determined for each region. Effort losses are summarized on Table V-13. Current losses amount to about 922 thousand angler hours. For Muskoka, Haliburton, Parry Sound and Southern Ontario, the losses were predominantly partial losses from Category II lakes. Parry Sound had some total (Category I) current losses. The majority (83%) of current losses have occurred in the Northeastern Region. Only 0.5% have occurred in the Northwest. These represent a loss of effort of about 1.1% for the susceptible areas of Ontario and about 0.9% of total available effort in all of Ontario.

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* Personal communication with Ministry of Natural Resources field staff.

** McCombie, S.M., Net Productivity As An Index of Cottages Impact on Fisheries. Ontario Ministry of Natural Resources, part of the Lakeshore Capacity Study, Phase III, Table 2C (draft).

EXHIBIT V-7

CALCULATION OF LOSS IN ANGLER EFFORT FOR MUSKOKA

ESTIMATES OF PRODUCTIVITY BY SUSCEPTIBILITY CATEGORY (KG)						
	I	II	III	IV	V	TOTAL
Base Line	0	0	34,926	84,600	13,249	132,775
Current	0	34,926	84,600	268	12,981	132,775
Scenario 1	34,926	84,600	268	0	12,981	132,775
Scenario 2	119,526	268	0	0	12,981	132,775

ESTIMATES OF PRODUCTIVITY LOSSES (KG) BY SUSCEPTIBILITY CATEGORY

	I	II	TOTAL
Current	0	6,985	6,985
Scenario 1	34,926	16,920	51,846
Scenario 2	119,526	54	119,580

Average MSY productivity (Harvest) = 2.11 kg/ha
Effort = 30.12 hr/ha
CUE = Harvest/Effort = 0.0701 kg/hr

80% MSY productivity (Harvest) = 1.69 kg/ha
Effort = 24.42 hr/ha
CUE = Harvest/Effort = 0.0692 kg/hr

TOTAL AREA EFFORT BASED ON CURRENT PRODUCTIVITY = 1,896,786 Angler Hours

ESTIMATES OF LOSS IN EFFORT (ANGLER HOURS)

	I 100%	II Partial	Total Loss
Current	0	94,462	94,462
Scenario 1	498,231	228,812	727,043
Scenario 2	1,705,078	725	1,705,803

Harvest vs effort function
Effort = $-0.3094 + 15.0042h - 0.1308h^3$ ($R^2 = 0.7570$)

EXHIBIT V-8

CALCULATION OF LOSS IN ANGLER EFFORT FOR HALIBURTON

ESTIMATES OF PRODUCTIVITY BY SUSCEPTIBILITY CATEGORY (KG)

	I	II	III	IV	V	TOTAL
Base Line	0	0	11,096	44,224	51,032	106,352
Current	0	11,096	44,224	40,944	10,088	106,352
Scenario 1	11,096	44,224	40,944	0	10,088	106,352
Scenario 2	55,320	40,944	0	0	10,088	106,352

ESTIMATES OF PRODUCTIVITY LOSSES (KG) BY SUSCEPTIBILITY CATEGORY

	I	II	TOTAL
Current	0	2,219	2,219
Scenario 1	11,096	8,845	19,941
Scenario 2	55,320	8,189	63,509

CALCULATION OF EFFORT

Average MSY productivity (Harvest) = H = 2.06 kg/ha
Effort = 24.76 hr/ha
CUE = Harvest/Effort = 0.0833 kg/hr

80% MSY productivity (Harvest) = H = 1.65 kg/ha
Effort = 21.74 hr/ha
CUE = Harvest/Effort = 0.0760 kg/hr

TOTAL AREA EFFORT BASED ON CURRENT PRODUCTIVITY = 1,276,735 Angler Hours

ESTIMATES OF LOSS IN EFFORT (ANGLER HOURS)

	I 100%	II Partial	Total Loss
Current	0	16,405	16,405
Scenario 1	133,205	65,384	198,589
Scenario 2	664,106	60,535	724,641

Harvest vs effort function
Effort = $9.5767 + 7.3649h - 0.0016h^3$ ($R^2 = 0.7196$)

EXHIBIT V-9

CALCULATION OF LOSS IN ANGLER EFFORT FOR PARRY SOUND

	ESTIMATES OF PRODUCTIVITY BY SUSCEPTIBILITY CATEGORY (KG)					
	I	II	III	IV	V	TOTAL
Base Line	0	1,128	15,682	102,780	7,431	127,021
Current	1,128	15,682	102,780	3,278	4,153	127,021
Scenario 1	16,810	102,780	3,278	0	4,153	127,021
Scenario 2	119,590	3,278	0	0	4,153	127,021

ESTIMATES OF PRODUCTIVITY LOSSES (KG) BY SUSCEPTIBILITY CATEGORY

	I	II	TOTAL
Current	902*	3,136	4,038
Scenario 1	16,810	20,556	37,366
Scenario 2	119,590	656	120,246

* losses limited to 80% of category I

CALCULATION OF EFFORT

Average MSY productivity (Harvest) = H = 2.53 kg/ha
Effort = E = 29.46 hr/ha
CUE = Harvest/Effort = 0.0859 kg/hr

80% MSY productivity (Harvest) = H = 2.02 kg/ha
Effort = E = 24.69 hr/ha
CUE = Harvest/Effort = 0.0818 kg/hr

TOTAL AREA EFFORT BASED ON CURRENT PRODUCTIVITY = 1,478,708 Angler Hours

ESTIMATES OF LOSS IN EFFORT (ANGLER HOURS)

	I 100%	II Partial	Total Loss
Current	10,501	29,192	39,693
Scenario 1	195,693	191,325	387,018
Scenario 2	1,392,200	6,102	1,398,302

Harvest vs effort function
Effort = $4.7489 + 10.0533h - 0.0450h^3$

EXHIBIT V-10

CALCULATION OF LOSS IN ANGLER EFFORT FOR REMAINDER OF ACID SENSITIVE SOUTHERN ONTARIO

ESTIMATES OF PRODUCTIVITY BY SUSCEPTIBILITY CATEGORY (KG)						
	I	II	III	IV	V	TOTAL
Base Line	0	0	314	73,846	562,535	636,695
Current	0	314	73,846	32,606	529,929	636,695
Scenario 1	314	73,846	32,606	0	529,929	636,695
Scenario 2	74,160	32,606	0	0	529,929	636,695

ESTIMATES OF PRODUCTIVITY LOSSES (KG) BY SUSCEPTIBILITY CATEGORY

	I	II	TOTAL
Current	0	63	63
Scenario 1	314	14,769	15,083
Scenario 2	74,160	6,521	80,681

CALCULATION OF EFFORT

Average MSY productivity (Harvest) = H = 3.69 kg/ha
Effort = E = 39.58 hr/ha
CUE = Harvest/Effort = 0.0932 kg/hr

80% MSY productivity (Harvest) = H = 2.952 kg/ha
Effort = E = 33.27 hr/ha
CUE = Harvest/Effort = 0.0887 kg/hr

TOTAL AREA EFFORT BASED ON CURRENT PRODUCTIVITY = 6,831,491 Angler Hours

ESTIMATES OF LOSS IN EFFORT (ANGLER HOURS)

	I 100%	II Partial	Total Loss
Current	0	537	537
Scenario 1	3,369	126,310	129,679
Scenario 2	795,708	55,771	851,479

Harvest vs effort function
Effort = $4.7489 + 10.0533h - 0.0450h^3$ ($R^2 = 0.6777$)

EXHIBIT V-11

CALCULATION OF LOSS IN ANGLER EFFORT FOR NORTHEASTERN ONTARIO

ESTIMATES OF PRODUCTIVITY BY SUSCEPTIBILITY CATEGORY (KG)						
	I	II	III	IV	V	TOTAL
Base Line	0	173,131	73,392	654,403	2,438,992	3,339,918
Current	173,131	73,392	654,403	286,517	2,152,475	3,339,918
Scenario 1	246,523	654,403	286,517	0	2,152,475	3,339,918
Scenario 2	900,926	286,517	0	0	2,152,475	3,339,918

ESTIMATES OF PRODUCTIVITY LOSSES (KG) BY SUSCEPTIBILITY CATEGORY

	I	II	TOTAL
Current	138,505*	14,678	153,183
Scenario 1	246,523	130,881	377,404
Scenario 2	900,926	57,303	958,229

* Losses limited to 80% of Category I lakes

Area CUE = 0.20 kg/hr

Total Area Effort = 16,699,590 Angler Hours

ESTIMATES OF LOSS IN EFFORT (ANGLER HOURS)

	Total Loss
Current	765,915
Scenario 1	1,887,020
Scenario 2	4,791,145

EXHIBIT V-12

CALCULATION OF LOSS IN ANGLER EFFORT FOR NORTHWESTERN ONTARIO

ESTIMATES OF PRODUCTIVITY BY SUSCEPTIBILITY CATEGORY (KG)						
	I	II	III	IV	V	TOTAL
Base Line	0	0	5,692	1,137,740	12,666,689	13,810,121
Current	0	5,692	1,137,740	5,643,433	7,023,256	13,810,121
Scenario 1	5,692	1,137,740	5,643,433	0	7,023,256	13,810,121
Scenario 2	1,143,432	5,643,433	0	0	7,023,256	13,810,121

ESTIMATES OF PRODUCTIVITY LOSSES (KG) BY SUSCEPTIBILITY CATEGORY

	I	II	TOTAL
Current	0	1,138	1,138
Scenario 1	5,692	227,548	233,240
Scenario 2	1,143,432	1,128,687	2,272,119

Area CUE = 0.25 kg/hr

Total Area Effort = 55,240,484 Angler Hours

ESTIMATES OF LOSS IN EFFORT (ANGLER HOURS)

	Total Loss
Current	4,552
Scenario 1	932,960
Scenario 2	9,088,776

EXHIBIT V-13

SUMMARY OF ESTIMATED EFFORT LOSSES IN ONTARIO

	ANGLER HOURS (000's)		
	CURRENT	SCENARIOS	
		1	2
Muskoka	94	727	1,706
Haliburton	16	199	725
Parry Sound	40	387	1,398
Remainder of Acid Sensitive Southern Ontario	1	130	851
Northeastern	766	1,887	4,791
Northwestern	5	933	9,088
Total	922	4,263	18,559
% of Susceptible Ontario*	1.1%	5.1%	22.2%
% of Total Ontario**	0.9%	4.1%	17.8%

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* Based on total estimated effort of 83,425 thousand angler hours.

** Based on total estimated effort of 104,237 thousand angler hours as calculated from SPOF working group No. 4 using 0.75 safety factor and average CUE of 0.20 kg/hr. Great Lakes are excluded.

EXHIBIT V-14

Example of Detailed Calculation of Loss in Effort

Calculation of Loss in Angler Effort for Haliburton (numbers are references to attached table).

1. Estimate of total productivity - 106,352 kilograms

   - derived from the sampled lake productivity of 57,488 (Ex. V-6)
   - grossed up by factor of 1.85
   - gross up factor derived from the ratio of total productivity based on watersheds for Muskoka, Haliburton, Parry Sound and Acid Sensitive Eastern Ontario to productivity estimates for sampled lakes in the same area

   $$\frac{\text{watershed productivity 1,003,000 kg (Appendix V p. 4)}}{\text{sampled lake productivity 542,047 kg (Exhibit V-6)}} = 1.85$$

   - productivity distributed by susceptibility category based upon Exhibit V-6 distributions for Haliburton.

2. Base line is attempt to estimate 'natural state' derived by shifting productivity one category away from acidified - based on judgement.

3. Based upon shifting productivity of current situation:

   Current $\text{II} \longrightarrow \text{I}$
   Current $\text{III} \longrightarrow \text{II}$

4. Based upon shifting productivity of Scenario I

   Scenario I - $\text{II} \longrightarrow \text{I}$
   Scenario I - $\text{III} \longrightarrow \text{II}$

5. Current productivity loss

   11,096 x .20 = 2,219 kg

6. Scenario #1

   11,096 + 44,224 x .20 = 19,941 kg

7. Scenario #2

   55,320 + 40,944 x .20 = 63,509 kg

8. Average MSY productivity (H)

   $$(H) = \frac{\text{sample lake productivity}}{\text{sample lake area}} = \frac{57{,}488 \text{ kg}}{27{,}907 \text{ ha}} = 2.06 \text{ kg/ha}$$

9. Effort in hours/hectare

   $\text{Effort} = 9.5767 + 7.3649\,H - 0.0016H^3$
   $E = 24.74$

EXHIBIT V-14
(continued)

10. CUE

$$\frac{\text{Harvest}}{\text{Effort}} = \frac{2.06}{24.74} = 0.0833 \text{ kg/hr.}$$

11. 20% MSY productivity (Harvest)

$$H = 2.06 \times .80 = 1.65 \text{ kg/ha}$$

12. $\text{Effort} = 9.5767 + 7.3649\ H - 0.0016H^3 = 21.72$

13. CUE with 20% reduction in productivity

$$\frac{X}{Y} = \frac{1.65}{21.74} = 0.0760 \text{ kg/hr}$$

14. Total area effort

$$\frac{\text{total productivity}}{\text{CUE}} - \frac{106{,}352}{0.0833 \text{ kg/hr}} = 1{,}276{,}735 \text{ hours}$$

15. Estimates of current loss - 16,405 hours

$$\frac{\text{current productivity category II}}{\text{CUE}} = \frac{11{,}096}{.0833} = 133{,}205 \text{ hours}$$

$$\text{less: } \frac{\text{80\% current productivity category II}}{\text{20\% CUE}} = \frac{8{,}877}{.0760} = \underline{116{,}800} \text{ hours}$$

$$\underline{\underline{16{,}405}} \text{ hours}$$

16. Estimates of Scenario 1 loss - 198,589 hours

$$\text{Category I} - \frac{11{,}096}{.0833} = 133{,}205 \text{ hours}$$

$$\text{Category II} - \frac{\text{scenario 1 category II productivity}}{\text{CUE}} = \frac{44{,}224}{.0833} = 530{,}900 \text{ ho}$$

$$\text{less: } \frac{\text{80\% scenario 1 category II productivity}}{\text{20\% CUE}} = \frac{35{,}379}{.0760} = \underline{465{,}516} \text{ hou}$$

$$\underline{65{,}384} \text{ h}$$

17. Estimates of Scenario II loss - 724,641 hours

$$\text{Category I} - \frac{55{,}320}{.0833} = 664{,}106 \text{ hours}$$

$$\text{Category II} - \frac{40{,}944}{.0833} = 491{,}525 \text{ hours}$$

$$\text{less: } \frac{40{,}944\ (.80)}{.0760} = \underline{430{,}989} \text{ hours}$$

$$\underline{60{,}535} \text{ hours}$$

EXHIBIT V-14
(continued)

CALCULATION OF LOSS IN ANGLER EFFORT FOR HALIBURTON

ESTIMATES OF PRODUCTIVITY BY SUSCEPTIBILITY CATEGORY (KG)						
	I	II	III	IV	V	TOTAL
Base Line[2]	0	0	11,096	44,224	51,032	106,352
Current	0	11,096	44,224	40,944	10,088	106,352 [1]
Scenario 1[3]	11,096	44,224	40,944	0	10,088	106,352
Scenario 2[4]	55,320	40,944	0	0	10,088	106,352

ESTIMATES OF PRODUCTIVITY LOSSES (KG) BY SUSCEPTIBILITY CATEGORY

	I	II	TOTAL
Current	0	2,219	2,219[5]
Scenario 1	11,096	8,845	19,941[6]
Scenario 2	55,320	8,189	63,509[7]

CALCULATION OF EFFORT

Average MSY productivity (Harvest) = H = 2.06[8] kg/ha
Effort = 24.76[9] hr/ha
CUE = Harvest/Effort = 0.0833 kg/hr[10]

80% MSY productivity (Harvest) = H = 1.65[11] kg/ha
Effort = 21.74[12] hr/ha
CUE = Harvest/Effort = 0.0760 kg/hr[13]

TOTAL AREA EFFORT BASED ON CURRENT PRODUCTIVITY = 1,276,735 Angler Hours[14]

ESTIMATES OF LOSS IN EFFORT (ANGLER HOURS)

	I 100%	II Partial	TOTAL LOSS
Current	0	16,405	16,405[15]
Scenario 1	133,205	65,384	198,589[16]
Scenario 2	664,106	60,535	724,641[17]

Harvest vs effort function
Effort = $9.5767 + 7.3649h - 0.0016h^3$ ($R^2 = 0.7196$)

APPENDIX VI

CASE STUDIES

APPENDIX VI

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VI. THE CASE STUDIES: RELATING RECREATION AND TOURISM TO THE RESOURCE BASE

At the commencement of this assignment it was intended that insight would be gained by examining lakes where acidification had occurred over recent years. Unfortunately, after extensive consultation in Ministries of Natural Resources and Environment plus review of topographic mapping and aerial photographs it was not possible to develop a list of lakes that were acidified recently and used extensively. To date most lakes that have currently acidified tend to be small, often very isolated and thus not well developed for recreation and tourist use. In addition, it appears that most of the damage occurred many years ago. As a result there are no records of the acidification process and user response.

In order to develop an understanding of the probable effects of acidic precipitation on aquatic-based recreation and tourism, in areas where lakes are sensitive to acidification, case studies were conducted. The case studies undertaken examine historic and current land use and recreational activity, the present resource base, and the current and projected response to changes in the resource. The case study areas, listed below, were selected in consultation wih Ministry of Natural Resources personnel, to represent a broad range in resource quality and recreational activity levels: Exhibit VI-1 shows the location of the case study areas.

- Sudbury Area - Chiniguchi Lake
  - Clearwater Lake
  - Kukagami Lake

- Parry Sound Area - Moon River/Wood's Bay

- Haliburton Area - Kennisis Lake
  - Lake Kashagawigamog

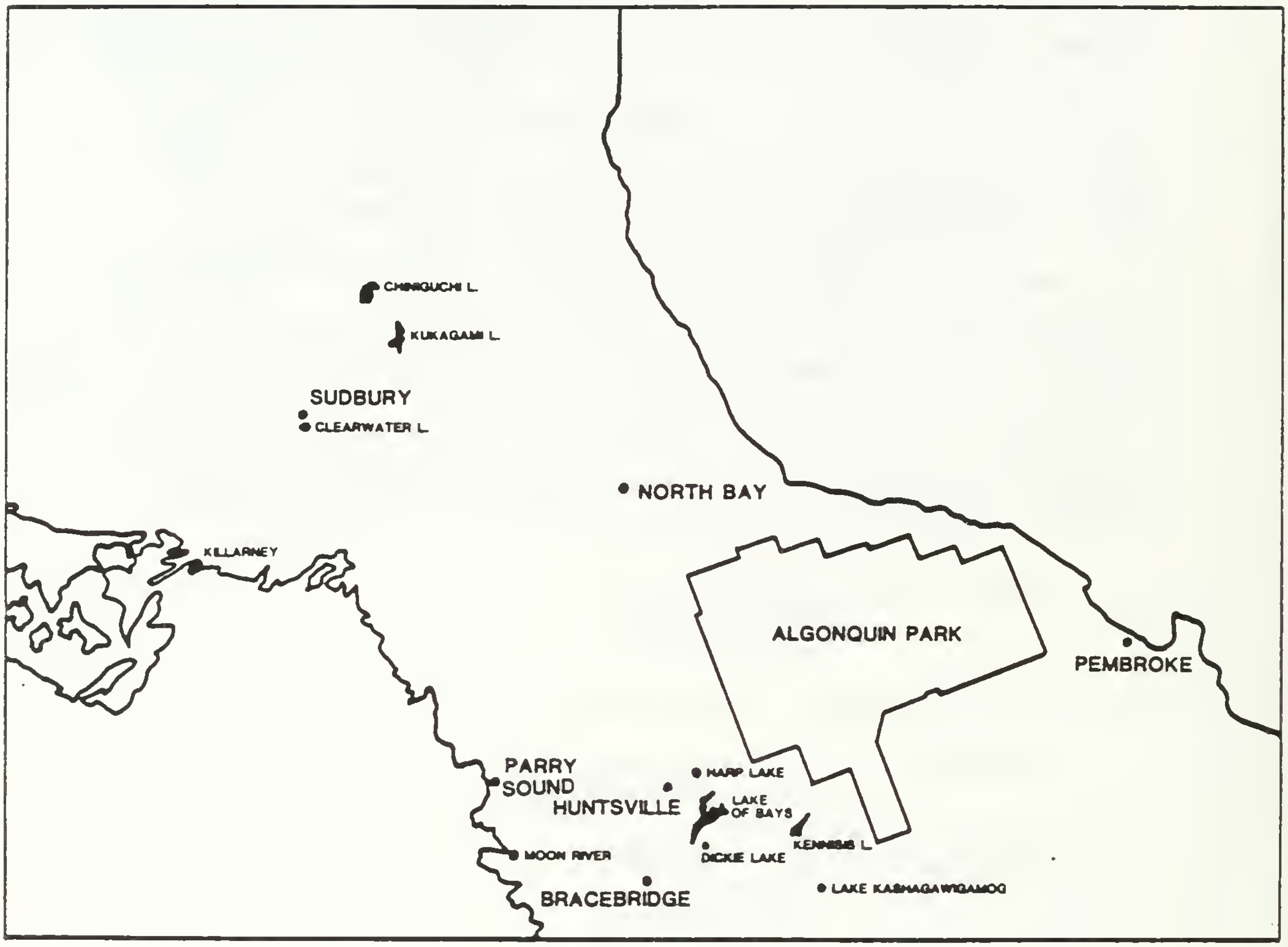
- Huntsville Area - Dickie Lake
  - Harp Lake
  - Lake of Bays

- Provincial Parks - Algonquin Park
  - Killarney Park

The following descriptions of land use patterns and recreational activity are based on field investigations by our staff, and examination of topographic mapping and aerial photography, and interviews with area residents and visitors. Data described in "The Resource Base" section are derived from the Environment Ministry's Acid Sensitivity Survey, the Natural Resources Ministry's Ontario Lakes Survey, and recent discussions with Ministry personnel. Fishing resource and water quality data are summarized for each lake in Exhibit VI-2, at the end of this Appendix.

EXHIBIT VI-1

LOCATION OF CASE STUDY AREAS



The basis for information in the 'Response to Resource Change' section (Part C) was the series of above-mentioned interviews, conducted with local cottagers, realtors, resort and campground operators, tourist association officials, and government personnel. More than 55 interviews were conducted. The questions asked were deliberately left open-ended, and an effort was made to engage each interviewee in conversation about study area conditions. A list of the questions normally asked each respondent group is given in Exhibit VI-3, at the end of the appendix.

A. THE SUDBURY AREA: CHINIGUCHI, CLEARWATER, AND KUKAGAMI LAKES

The Sudbury area has a long history of being subject to the effects of sulphur dioxide emissions. With the construction by INCO in 1972 of 1,250 foot 'superstack', the impact of acidification in the Sudbury area has been lessened. The effects of the nickel operation in Sudbury are now distributed over a much broader area. Of the three lakes selected Chiniguchi and Clearwater are acidified while Kukagami is experiencing partial effects of acidification.

Of the three case study lakes in the Sudbury area, Clearwater Lake enjoys by far the best access to the City. Located within the Regional Municipality of Sudbury, some 18 kilometres south of the City of Sudbury, Clearwater Lake is served by a well-maintained year-round road, which connects to Regional Road 80 (Paris Street), the main north-south arterial road in the Region. Chiniguchi Lake is located approximately 70 kilometres northeast of the City. Access is by gravel road. Kukagami Lake is located approximately 55 kilometres northeast of the City. Kukagami Lake is reached via 30 kilometres of highway and 25 kilometres of gravel road. Neither Chiniguchi Lake nor Kukagami Lake is serviced with electricity at present.

1. Land Use Patterns and Recreational Activity

Cottage development first took place on Kukagami Lake in 1957, shortly after the road was constructed. There are presently about 80 cottages on the lake, none of which is used year-round, due, in part, to the lack of hydro. The only year round residents are the proprietors of the one resort on the lake, Sportsman's Lodge.

According to local realtors' estimates, Clearwater Lake was first developed for cottages some 40-50 years ago; today there are approximately 15 cottages, most of which are used year-round, and the same number of permanent residences. Prior to 1976, the land around Clearwater Lake was under a zoning order by the Minister of Housing freezing development; now these lands are under an interim zoning by-law, which allows some residential development. The lake is not well-developed, and there were no permanent residences on lake before 1976. There are no cottages on Chiniguchi Lake other than Chiniguchi Camp, the only resort on the lake.

It was the consensus of local realtors that demand for cottages in general in the Sudbury area was quite strong, and supply was very low. Often cited as important determinants of cottage demand were access to Sudbury, year-round access, lot size, services, a nice beach, good drinking water, scenery, and fishing. Asked to compare demand for an identical cottage on Clearwater Lake and Kukagami Lake, they all stated that demand on Clearwater would be much higher. They estimated that there would be a premium in price of approximately 50-80% for property on Clearwater. The major factor in this difference is access to Sudbury (Sudbury is by far the major cottage market in the area - there are very few cottagers from southern Ontario). Within 30 miles (approximately 50 kilometres) or what was referred to as "commuting distance", demand is extremely high. It is becoming quite common in that area for people to winterize their cottages and sell their urban home. Clearwater Lake is no exception is this respect; since it has such good access to town, it is becoming a prestigious lake on which to have a home. Outside the commuter shed, the other factors outlined earlier in the paragraph take on more importance.

Each realtor was specifically asked how important fishing was to cottagers on the case study lakes. After pointing out that fishing was not important at all on Clearwater because of access and the fact that there were no fish in the lake (because of its acidity), realtors were less definite about Kukagami. Since Kukagami Lake is close to the 50-kilometre commuter radius, they thought that access to Sudbury may still have some importance. On the other hand, some thought that fishing may be a major activity of cottagers. A representative of the Cottagers Association said that fishing was a prominent activity of some cottagers, but probably not the major attraction of the lake. He cited access to Sudbury (saying a one-way trip can be made in close to 45 minutes), other activities, including swimming and boating, and the clean and clear water as probably being more important. In general, Kukagami Lake is regarded as a fishing and recreation lake. Finally, it was noted by realtors that ardent fishermen are not usually cottagers; they go where the fish are, mainly the French River area.

There are only two resort operations on the case study lakes in the Sudbury area, Chiniguchi Camp and Sportsmen's Lodge. There was once another lodge on Kukagami Lake called Gord's Lodge, but it closed several years ago. Chiniguchi Camp was started in 1946, with one cabin and accommodation for two guests. Business grew until the early 1960's when "water quality" became noticeably poorer; the owner attributes the decline directly to INCO. Now, the owner says there are no fish in the lake, noting that a few years ago the government netted the lake for 8 days, and came up with two suckers and a few perch. The owner also used to rent cabins to moose hunters, but the Ministry of Natural Resources closed the moose season for American hunters in the Chiniguchi Lake area, so that business has been eliminated as well. At present there are no plans to re-open Chiniguchi Camp in 1981.

Sportsmen's Lodge opened on Kukagami Lake approximately 35 years ago. In the early days of the lodge, 95% of the guests were American; now the proportion is more like 65%. Fishing was originally by far the biggest attraction of Sportsmen's Lodge. People are now looking for a little luxury, more water sports, tennis, etc. and fishing is somewhat less important. Most of the avid fishermen now use the fly-in service offered by the lodge; the flights are up to 35 miles, mainly to the northeast. Sportmen's Lodge has just this season begun to stay open in the winter, and offers cross country skiing, and snowmobiling.

2. The Resource Base

For Chiniguchi Lake, the remarks made by the operator of Chiniguchi Camp and local realtors seem to be borne out by the data presented in Exhibit VI-2 at the end of the Appendix. There is no fishing, with yellow perch being the only species in the lake to any measureable extent; the lake is highly acidic and has a lack of buffering capacity. Similarly, the views of local people reflect the Ministry's data on Clearwater Lake: a highly acidic lake with a lack of buffering capacity and virtually no fish.

On Kukagami Lake, local people report that fishing worsened considerably in the 1960's, due, in their opinion, to the emissions of the Falconbridge Iron Plant at Coniston. During that period, there was a red residue on everything in the Kukagami Lake area. The plant was shut down 6 or 7 years ago, and in the past two or three years, water quality has improved and the fishing resource has begun to recover. The slow recovery of the bass as well as feed for fish (crayfish, leeches), is of particular concern to people on the lake. It is thought that the INCO "superstack" at Copper Cliff is high enough for emissions to have little effect on Kukagami Lake.

Data on fishing and water quality on Kukagami Lake, supplied by the operator of Sportsmen's Lodge and a representative of the Cottagers' Association, are generally consistent with the most recent data available from the provincial government. According to the Ministry figures, the lake is somewhat more acidic (pH=5.3) than is thought by the Cottagers Association, which believes that the lake ranges from a pH of 6.5 to 6.9 in the summer to pH 5.5 in spring, due to the melting of acidic snow.

This seasonal fluctuation pattern is thought to be quite significant, since the major species in the lake (lake trout) spawns in the fall and the fish would not be subjected to the most acidic conditions at this important time. Other important species in the lake are smallmouth bass, yellow perch and whitefish. The Ministry data include pickerel (walleye) as well, but this species was not mentioned by local people.

3. The Response to Changes in the Resource Base

The most important factor in cottage demand in the Sudbury area is whether the cottage is within commuting distance. For cottages within that distance, other factors such as the quality of the fishing become much less significant. This is amply evident on Clearwater Lake, where the fishing resource has already declined to zero, yet demand is high and prices are much higher than at lakes outside the commuter shed. The commuter shed argument is further supported upon examination of Kukagami Lake. Realtors were ambivalent in estimating the effect of a decline in fishing quality there, reflecting the fact that Kukagami Lake is on the commuter shed border. In general, it can be stated, though, that both realtors and the Cottagers Association felt that the effects of such a decline would be small or negligible on Kukagami Lake. Some used the commuter shed argument, some spoke of the great number of alternative activities, while others said that people have become used to the idea that the quality of sport fishing is not what it used to be and are simply less interested in it.

According to personnel of both the Ministry of Industry and Tourism and the Rainbow Country Travel Association, fishing is quite important to resorts in the Sudbury area. The French River, Manitoulin and Parry Sound areas are more family oriented. The accessible wilderness is the area's greatest selling point, and fishing is a very important part of that. The importance of fishing is certainly quite evident in the case of Peter Peloquin's Chiniguchi Camp. Subjected to acidification, Chiniguchi Lake could no longer support a fishery, and since fishing was the major attraction of the resort, Peloquin was forced to close.

The situation is somewhat different at Sportsmen's Lodge on Kukagami Lake. Subjected to acidification throughout the 1960's and early 1970's, the fishing declined markedly, and the owner suffered a considerable loss of business, particularly from Americans. In the early days of Sportsmen's Lodge, probably 95%

of guests were Americans; now the figure is approximately 65%, with most of the remainder coming from Southern Ontario. Probably the major reason for Sportsman's Lodge to be still operating today is the resourcefulness of the operator in attempting to compensate for fishing problems. In the 1960's, he introduced the fly-in fishing service. Now, an attempt is being made to operate year-round, with more emphasis on the alternatives to fishing, and a little more luxury. Asked about the impact of a significant decline in the quality of fishing, the owner thought that he is presently better prepared than he ever has been to compensate for the problem, but still felt that the impact would be sizeable, since anything other than fishing which he can offer his guests (natural setting, water sports, tennis, etc.) can probably be found closer to their place of residence. For those resorts less prepared and with less capital to put into their operations, the impact would definitely be greater.

B. THE PARRY SOUND AREA: MOON RIVER/WOOD'S BAY

This area, where the Moon River enters Georgian Bay, is some 220 kilometres north of Toronto. Wood's Bay can be reached via a road extending 18 kilometres west from District Road 612 north of Mactier, but most of the area can be reached only by boat in summer and snowmobile in winter. The area we have defined for case study purposes extends from Wood's Bay in the west to Arnold's Bay in the east.

This area was chosen as a case study area, as recently there has been a significant reduction in the quality of the fishing. This area has traditionally attracted visitors for this resource. The reasons for the decline in fishing quality are not clear, but the effects of "acid pulses" and over fishing on the Great Lakes appear to be the most likely explanations.

1. Land Use Patterns and Recreational Activity

Other than at the lodges themselves, there are approximately 15 cottages in the Moon River/Wood's Bay area. The amount of sales activity in the area is understandably low with so few cottages in the market, so it is difficult to discern any demand patterns. There are approximately 12 families of year-round residents, about half of whom are resort owners.

Resorts in the study area are small, usually with 3-5 cottages; there are seven in Moon River/Wood's Bay comprising a total of 27 cottages and one lodge accommodating 6 persons. The oldest of these resorts has been running for 15-20 years, but most began operation in the late 1960's or early 1970's. Some of the resorts run year-round, but since access for many is only via water or ice, it is a difficult objective to meet. The bulk of resort guests comes from Southern Ontario, and there is a large American component as well, ranging between 20% and 40% of total business. The numbers of Americans have decreased significantly over the past few years.

Fishing was reported to be the major activity of resort guests in the summer and especially in the spring and fall. The amount of business from fishermen has decreased over the past few years, due to a decline in the quality of the fishing resource, and family vacationing in the summer has increased somewhat in importance. However, resort owners interviewed indicated that the majority (as much as 98%) of their business is still from fishermen, with the remainder from family vacationers. Other than fishing, the major activities of family vacationers are swimming, boating, waterskiing and sunbathing in the summer, and snowmobiling and, to a lesser extent, cross country skiing in the water.

2. The Resource Base

A few years ago, the Moon River/Wood's Bay area had a reputation as the number one area in North America for pickerel (walleye) fishing, recently the quality of fishing has declined. Resort operators in the area concur that the pickerel have been seriously depleted, with one proprietor suggesting that the pickerel fishing success rate is one-quarter of what it was 5 years ago. The relatively low 'catch per unit effort' figure shown in Exhibit VI-2 supports this assertion. Tourist businesses in the area depend on the pickerel fishery in spring and fall particularly, because the pickerel season opens earlier in the spring and closes later in the fall than the bass and maskinonge (muskellunge) seasons. The other major species in the area is northern pike (as shown in Exhibit VI-2) and resort owners indicated that crappie and splake were also caught. Although the depletion of pickerel is probably the most damaging to the resorts from the economic point of view, the fishing decline has not been restricted to this species. Operators reported that maskinonge have also been depleted, and the bass fishing, although worse than before, seems to be 'keeping the bay open' at present.

Resort operators attribute the decline in fishing quality to excessive commercial fishing, poor fish management by the Ministry of Natural Resources, and pollution in the area. One operator referred to this area as the 'cesspool of the Muskoka Lakes', the sources of the problem being the dam at Bala, and unlicenced cottage owners in the area renting their cottages regularly to polluters. Although this form of pollution may be a problem in the area, Exhibit VI-2 shows that acidity is probably not at present a major contributor to the resource decline. The pH of the water ranges from 5.9 to 6.7, and the buffering capacity figure indicates moderate sensitivity to acidification.

3. The Response to Changes in the Resource Base

To some extent, the impact of the fishing resource decline has already been felt by tourist operators in the area. Business in May-June and September-October has fallen off considerably. Efforts to compensate for this loss by promoting family vacations in the months of July and August have met with limited success.

The effects on the cottage market of a decline in the fishery are extremely difficult to determine, given the small number of cottages. It is reasonable to assume, though, that cottage use in spring and fall will decrease markedly; there has been some decline in spring and fall usage already.

Unfortunately, the problem is worsening. It was said that 1980 had much poorer fishing than either of the two previous years, and the impact of this will be felt next year in the loss of repeat and word-of-mouth business from fishermen. Fishermen visiting in spring and fall provide tourist operators in the area with the majority of their revenue. Even if local operators were to attain 100% occupancy by family vacationers in the summer, in most cases this would not compensate for the huge losses in spring and fall. Asked about a further decline in the fishing resource, resort operators believe that a number of businesses would be lost. In the words of one: "I'd have to sell out, starve or wait until the bank takes the place off my hands".

C. THE HALIBURTON AREA: KENNISIS LAKE, LAKE KASHAGAWIGAMOG

The Village of Haliburton is located approximately 210 kilometres northeast of Toronto. Lake Kashagawigamog is 3 kilometres southwest of Haliburton, while Kennisis Lake is approximately 30 kilometres north of the Village. This additional distance to Kennisis Lake translates into approximately 30-45 minutes in driving time. Both lakes are served by year-round roads and are large enough for most types of power and sail-boating. These lakes where chosen for case study as they have quite different levels of fishing quality. Kennisis is considered to be the superior fishery. By examining two lakes in close proximity, it was hoped that some understanding of the importance of fishing could be determined.

1. Land Use Patterns and Recreational Activity

Kennisis Lake was first developed for cottages in the period 1956-1958; the original plan of subdivision was approved in 1956. The south shore was developed first, followed by the east and then the north sides. There are now approximately 600 cottages on the lake, of which 20 are used by permanent residents. Possibly 250-300 of the cottages are used some time during the winter; many cottages on Kennisis Lake have been winterized in the past 5 or 6 years. At present, there is a small amount of cottage development taking place on the lake.

Lake Kashagawigamog started out mainly as a resort lake. After a number of resorts had been built in the early 1930's, people started to build cottages. At present, the lake is quite densely developed with both cottages and resorts. The number of dwellings on the lake is estimated at about 500, approximately half of which are permanent homes, and a large proportion of the cottages are used year round.

Realtors indicated that cottage demand on the two case study lakes was quite strong, particularly at the lower end of the scale, in the $25,000 - $30,000 range. Factors cited as influencing cottage demand included year round access, access to town (for shopping), access to Toronto, clean water, a large water surface on which to boat, waterfront property, services, scenery, and fishing. Asked to compare the demand and price of an indentical cottage on Kennisis and Kashagawigamog, all realtors said demand on the latter would be much higher, and the price differential estimates ranged from 20% to 40%. This is due mainly to Kashagawigamog's superior access characteristics, as well as the extensive waterway available to cottagers on that lake.

Fishing was thought by local realtors to be more important to prospective cottage buyers on Kennisis Lake than on Lake Kashagawigamog. It was indicated that between 30% and 50% of prospects looking at Kennisis indicate an interest in fishing, while the corresponding percentage for Kashagawigamog is very small. A representative of the Kennisis Lake Cottagers Association estimated that perhaps 15% of cottagers could be considered fishermen. Power boating, waterskiing, sailing and swimming are more prevalent summer activities; winter sports include ice fishing, snowmobiling and cross-country skiing. On Lake Kashagawigamog, fishing is thought to be much less significant, with the emphasis on the above-mentioned activities. On both lakes, year-round use is increasing.

Although the period of most extensive resort development on Lake Kashagawigamog was in the 1930's, interviews were conducted with operators of resorts opened as early as 1916 and as late as 1976. At present, there are approximately 20 resorts operating in the vicinity of Lake Kashagawigamog, ranging from campgrounds and small housekeeping cottage operations to large resorts with numerous recreational facilities. The vast majority of guests reside in Southern Ontario, with operators indicating that between 5% and 30% of their clientele are American. Fishing was not considered a very important activity by resort operators interviewed. People said that Haliburton was more of a family vacation area then a fishing area; there are no fishing lodges on the lake. Other water sports and sometimes golf were thought to be more significant, even though it was the opinion of most operators that the fishing resource had not declined significantly over the past several years. The only resort operating directly on Kennisis Lake is a small cottage operation begun some 27 years ago. Fishing is among the most prevalent activities of guests, which include swimming, boating, horseshoes and pot-luck suppers. Fishermen tend to visit more in the spring than in the summer, and provide a substantial portion of the resort's revenue, although it is probably more of a family vacation spot.

2. The Resource Base

In the 1950's and 1960's, the major fish species caught in Kennisis Lake was lake trout, and people on the lake still consider the lake trout fishing quite good. Since the early 1970's, bass have been introduced into the lake, and apparently the bass fishing gets much better each year. No one is quite sure how the bass managed to get into the lake, although there is some speculation that fishermen may be dumping bass minnows after fishing. Other than the lake trout and bass, the only major sport fish species is yellow perch, according to latest data from the Ministry of Natural Resources; local people interviewed did not mention perch. One of the major concerns of fishermen on Kennisis Lake is lack of feed (e.g. minnows, crayfish and leeches) for the fish, which may stunt their development. It was suggested that perhaps instead of stocking fish in the lake, the Ministry of Natural Resources should stock feed.

Water quality of Kennisis Lake is considered by cottagers and residents to be quite good, with approximately 90% of cottagers taking their drinking water directly from the lake. The lake is becoming clearer, which cottagers initially thought was quite good, but now are concerned that this may indicate that the lake is being acidified. Data in Exhibit VI-2 measuring water quality in the lake seem to indicate that this is a possibility. The pH shows only slight acidity in the lake, but the buffering capacity is relatively low.

The major species caught in Lake Kashagawigamog are described in Exhibit VI-2. Although locals did not mention yellow perch and brook (speckled) trout, they did say that there were small numbers of larch and possibly pike caught. The opinion of the local people about the quality of fishing on the lake varies considerably, although most agree that the quality of the resource has changed very little in the past few years. Natural Resources data in Exhibit VI-2 indicate that the catch per unit effort is only slightly lower than that of Kennisis Lake. One resort operator said that the fishing in 1980 was quite good, particularly for bass. Others said that in order to catch fish in Lake Kashagawigamog you need to know how to fish properly and know the lake; the fish are quite well fed, and disturbance from airplanes and motorboats on the lake reduces fishing success. However, fish can still be caught. Finally, one realtor thought that there was very little fishing on the lake, blaming pollution for the poor quality of the resource. He referred to the extremely high density of development of both cottages and resorts on the lake, saying that sewage disposal was a real problem, and the lake has definitely suffered. Referring to Exhibit VI-2, acidity is shown not to be a problem at present. The water is slightly on the basic side of neutral, and the lake has quite a high buffering capacity.

3. The Response to Changes in the Resource Base

Those interviewed on Kennisis generally felt that a significant decline in the fishing resource itself would not cause any major effects on the amount of cottage use or on the cottage market. People were more concerned with the water quality question. If people were led to believe that such a decline in fishing was indicative of a decline in water quality to the extent that drinking or swimming in the water became dangerous, those interviewed felt there would be widespread effects on cottaging. This situation would be aggravated if the names 'acid dead' or 'highly acidified' were attached to the lake. The decline in fishing itself, however, would probably cause only a small economic impact on cottaging on Kennisis.

A decline in the fishing resource itself would cause a similar type of reaction on Lake Kashagawigamog. It is important to realize, however, that fishing is much less important to cottaging on Kashagawigamog, and the effect would be accordingly smaller. Should human health become a problem (i.e. swimming or drinking hazards) there would be a massive impact on cottage use and the cottage economy. Resort operators emphasized that people's perception of a problem is just as significant as the actual physical problem. Even if a health hazard is unproven, people will be very conscious of any publicity regarding such a hazard, and may react accordingly.

It is interesting to note that many people in the Haliburton area tend to associate water quality problems with acid rain; they acknowledge that other pollution may exist, but still mention acid rain as a major contributor. It is particularly interesting to hear this complaint from people at Lake Kashagawigamog where, based on Ministry data, acidification is not a problem at present.

For the resort on Kennisis Lake, a decline in the fishing resource base would probably affect the resorts significantly, but could probably be compensated to a large extent by increased promotion of family vacations. Kennisis Lake has enough alternative activities available for guests, and access to Southern Ontario is fairly good. Resort operators on Lake Kashagawigamog indicated that fishing was generally not important to their guests, and such a decline would have little or no effect. However, if a lake is declared 'dead', this may have an effect on the image and appeal of the lake and reduce business. As one operator put it: "People think northern lakes are supposed to have fish in them". The health hazard scare is also a worry of resort operators. Negative perception is a problem for both resorts and cottagers, but is probably felt more acutely by the resorts, since the image of an area is so important to vacationers.

D. THE HUNTSVILLE AREA: DICKIE LAKE, HARP LAKE, LAKE OF BAYS

Huntsville is approximately 215 kilometres north of Toronto. The drive normally takes just over two hours, since the major route via Highways 400 and 11 is a 4-laned highway with limited access in parts. Lake of Bays is approximately 20 kilometres east of Huntsville on Highway 60. Dickie Lake is near the southern end of Lake of Bays, about 2 kilometres due east of Baysville. Harp Lake is closer to Huntsville than either of the aforesaid mentioned, the distance being 11 kilometres east on Highway 60 and north on Harp Lake Road. All of the lakes under study in this area are accessible via year-round roads. Harp Lake and Dickie Lake are both small (approximately 1 square kilometre) while Lake of Bays is quite a large lake with extensive waterways for boating.

These three lakes in close proximity were chosen to gain insight into the implications for decline in fishing quality on different types of lakes in the Muskoka area.

1. Land Use Patterns and Recreational Activity

Cottage development first took place on Lake of Bays just prior to turn of the century. There are now approximately 1,600 dwellings on the lake, a number of which are year-round residences. The remaining cottages are, to a large extent, used year-round, since road access in winter is good.

The land around Dickie Lake was originally owned by a farmer named Moses Dickie. Some 35-40 years ago, the first cottages on Dickie Lake were built on the west shore. Today there are approximately 128 cottages on the lake, out of 143 surveyed lots. Almost half of the cottages are used sometime during the winter, and there are 5 families of year-round residents.

Harp Lake was originally developed in the mid-1960's. There are now approximately 90 cottages on the lake, six of which are occupied by year-round residents. On all three lakes, the period of 1964-1969 was one of extensive cottage development, since there was no subdivision control until 1969. At present, there are very few undeveloped lots on any of the three lakes.

Cottage demand in general is still quite strong in the Huntsville area, according to local realtors, although it may be somewhat weaker than in 1976 when demand was extremely high and thought to have peaked. The rapid escalation in cottage prices has had some effect on demand but not a major impact; people now tend to be somewhat more selective. Asked to compare the price of an identical cottage on each of the three study lakes, the consensus of local realtors was that a $50,000 cottage on Dickie Lake would be worth $60,000 on Harp Lake, and $80 - $90,000 on Lake on Bays. The major factor in the price difference between Harp and Dickie is Harp's superior access to Huntsville. The major factor in the difference between Lake of Bays and the other two lakes in the extensive waterway afforded to boaters by Lake of Bays. Other than access to town and an extensive area for boating, major factors in cottage demand suggested by local realtors include prestige of the lake, year round access, scenery, and access to Toronto.

Each realtor was asked how important fishing was to cottage buyers. Most felt quite strongly that fishing was not an important factor in cottage demand, saying that possibly 1% - 10% of potential buyers even mention the subject. The small number of fishermen that are looking for cottages tend to buy in the low range ($20,000 - $30,000). Demand is not strong at all in this range. The priorities seem to have shifted to the availability of family type recreation. Other activities that have become more important than fishing include swimming, sunbathing, power boating, water-skiing, canoeing and sailing in summer, and cross-country skiing and snowmobiling in winter. Representatives of the Cottagers Association on all three lakes believed that fishing was important to only a small proportion of cottagers. For example, a cottagers' association survey of Harp Lake cottagers in 1972 indicated that swimming, canoeing, sailing, and pleasure boating were more important than fishing.

Although there are no resorts on Harp or Dickie Lake, there are approximately 20 of them on Lake of Bays. Resorts would have been first built just before the turn of the century, with two of the first resorts opened being Bigwin Inn and Lumina Lodge. Most tourist accommodation, however, was built in the 1940's after the Second World War. Today the bulk of the resorts' business comes from Southern Ontario; the proportion of Americans is small. Resort owners generally said that fishing is not important to their operations. Local representatives of the Ministry of Industry and Tourism and the Muskoka Tourist Association believe that Muskoka doesn't really have a high profile for fishing, and the only operators for whom fishing is important are the very few outfitters and fly-in fishing operations; these may fly fishermen as far as 50 miles from their base to find good fishing lakes.

Many Lake of Bays resort proprietors recognize the lack of great fishing and note that many fishermen will bypass the area to go further north and east, or stay with the family for a week on Lake of Bays, and then go fishing much further afield. The types of activities that were suggested as important to cottagers are also important to resort guests. A number of proprietors pointed out that their most important feature was a safe beach for the children.

2. The Resource Base

As shown in Exhibit VI-2 and indicated by local cottagers and realtors, the major fish species in Lake of Bays are smallmouth bass, lake trout, brook (speckled) trout, and whitefish. Ministry of Natural Resources data indicate that yellow perch is also a major species, and local people suggested that ling were present in the waters as well. Most people interviewed believe that the fishing quality has declined over the past several years, particularly in the case of lake trout, the most sought-after sport fish in the area. Most people believe that there are still large numbers of lake trout in the lake. Local people believe that the problem with lake trout seems to be that smelt have been introduced into the lake, and the lake trout feed on the smelt. Not only do the fish no longer take bait, but by eating the smelt they build up oily substances making the smell and taste of the trout quite unpleasant. Other reasons given for the general decline in the fishing resource include acid rain and other pollution, boat traffic, and government regulation of water levels, leaving spawning grounds high and dry. In general, though, locals believe that if a fisherman really knows what he is doing, he will probably catch fish. This opinion is supported by the moderately low 'catch per unit effort' figure shown in Exhibit VI-2. Water quality data relating to acidity show that the lake is almost neutral, but will be extremely sensitive to acidification.

In Harp Lake, the major species are lake trout and smallmouth bass. Cottagers on the lake suggest that yellow perch are being caught in increasing numbers, while the Natural Resources Ministry cites speckled trout as a Harp Lake species. People on the lake feel that fishing quality on the lake may have declined slightly over the past several years, but the reduction in fishing success is probably due in part to the fact that there is a lot of feed in the lake. Water quality for drinking is felt to be only marginal on Harp Lake, with probably less than 10% of cottagers drinking directly from the lake. This is due mainly to pollution problems other than acidification. Data on acidity shown in Exhibit IV-2 indicate that Harp Lake is slightly acidic with a moderate sensitivity to acidification.

The major species of fish on Dickie Lake are, according to the Ministry of Natural Resources, smallmouth bass and yellow perch. However, according to a Baysville realtor, 1,800 lake trout were stocked last year, and there are some whitefish in the lake. On Dickie Lake, people feel that the fishing is still reasonable, but are quite concerned about acid rain. They have been given to understand that the lake is fairly acidic now and is extremely sensitive to acidification; this is borne out in data shown in Exhibit VI-2. A complicating factor mentioned by a number of people was the erection of beaver dams on the streams feeding or draining the lake. They felt that the natural flushing of the lake would be inhibited by these dams, and would make the lake even more vulnerable to acidification.

3. The Response to Changes in the Resource

A decline in the quality of the fishing resource appears important to only a small proportion of the cottagers in the Huntsville area. In the words of one realtor: "Cottagers are not fishermen and fishermen are not cottagers". Ardent fishermen are generally not satisfied with the fishing in the area and will go elsewhere if they are interested in fishing. The cottager in the area now tends to be someone who is interested in more than a basic shack, and is also interested in a wide variety of aquatic activities, particularly on the larger lakes. The increasing year-round use is also indicative of a typical cottager in the area.

Rather than the fishing decline, cottagers are concerned about a decline in the quality of the water in terms of both drinking it and the danger to health in swimming. As with the Haliburton area, people are very concerned about the acid rain problem and are easily frightened by the connotation 'acid dead'. Some cottage buyers are hesitant even now. As an example, a realtor at Dickie Lake said that one cottage buyer she dealt with last year attempted to back out of a deal once he discovered that the lake was highly acid-sensitive. Again this is largely a fear of possible drinking and swimming problems rather than a concern with fishing.

With resorts, the situation is much the same. The ardent fishermen no longer come to the area to any extent. Guests now want a safe beach for the children, pretty scenery, and a variety of available activities; this is a family vacation area. The concern is not about fishing quality but about water quality; Ministry of Industry and Tourism staff are often asked by potential vacationers if the water is safe to swim in. People are well aware of the existence of acid rain, and any negative publicity about acidification and its effect on health is going to have major repercussions on the area's tourist economy.

E. THE PROVINCIAL PARKS: ALGONQUIN AND KILLARNEY

Algonquin Park occupies some 1,862,500 acres (765,345 hectares) of land and water in the centre of a triangle bounded roughly by Huntsville, Pembroke and North Bay. The major access to the park for Southern Ontario residents is along the 'Highway 60 Corridor'; the western gate is approximately 40 kilometres east of Huntsville. There are other roads on all sides of the park that lead to the interior, but Highway 60 handles the bulk of the traffic. Killarney Park is approximately 95 kilometres southwest of Sudbury via Highway 69 and Regional Road 637. Access to Toronto, 400 kilometres away, is provided by Highway 69 and Highway 400. The Park occupies some 84,900 acres (34,421 hectares) including several interior lakes: as well, parts of the park front onto Georgian Bay.

These case studies were chosen as many of the lakes in Killarney Park are currently acidified while Algonquin Park is considered to still provide good fishing opportunities.

1. Land Use Patterns and Recreational Activity

In the mid-1850's, the first pioneer loggers pushed up from the Ottawa Valley into what is now Algonquin Park, in search of white pine. By the time the park was established in 1883, most of the big pine had been cut for square timber; today there are only two stands of original white pine, one near Crow River and the other near Dividing Lake. The production of sawn lumber and its sale to Britain took over in the last half of the 19th century. With the natural environment already significantly altered by 1893, the park was created to protect wildlife as well as the headwaters of the major rivers in the area, rather than to stop the logging entirely. Recreational activity in the park did not really begin until after 1896 when the Ottawa, Arnprior and Parry Sound Railway was built; for the first time, the park was truly accessible to large numbers of people. As a result, numerous lodges were built in the park in the early part of the 20th century, and the first private leases for lakeshore lots were issued at this time as well. Six hundred leases were granted before their issuance was discontinued in 1954; the last lease issued will expire in 1996. A number of youth camps were established in the early 1900's, again in response to the introduction of access by train.

According to the Algonquin Park Master Plan dated 1974, there are three private lodges in the park, providing accommodation for 235 persons, all of which are located in the Highway 60 Corridor. As well, seven children's camps and approximately 350 private cottages are located within park boundaries. Algonquin Park has been designated as a 'Natural Environment Park'; these parks are meant to combine recreational and educational opportunities, are not intensely developed for recreational, and possess outstanding historical and natural features.

Camping in the main portion of the park begins in the last week of April, and ends on the Labour Day weekend. On some sites, the season opens the same time, but closes Thanksgiving weekend. The opening dates correspond with the beginning of trout season. There is one year-round site that campers can use in winter as well. Day-users can use the park to canoe or hike at any time of the year, but if they want to fish, they are restricted by the fishing seasons.

Killarney Park was named after Killarney Village, a fur trading centre on Georgian Bay dating back to 1820. By the early 1880's, the village had become important as a fishing centre, and logging in the area had begun. Early tourism centred around the Baie Fine area, which became a centre for the yachting class. The park has long been a haven for artists, its landscape providing inspiration for members of the Group of Seven, including A.Y. Jackson and Frank Carmichael; Trout Lake was renamed O.S.A. Lake in honour of the Ontario Society of Artists. In 1933, partly due to pressure from artists, logging was stopped in the O.S.A. Lake area and a nominal park was created. It was not until 1964, however, that Killarney Provincial Park officially came into being. Killarney Park has been designated a wildnerness park where nature is left pretty much alone. Visitors travel by foot or canoe rather than by car or motorboat and have a chance for intimate contact with nature.

The park season officially opens on Victoria Day weekend, and closes on Labour Day weekend. During the off-season, the gate is not manned and so no statistics are kept, but Natural Resources personnel believe the number of visitors is quite small. There are approximately 20-25 cottages and 140 campsites within park boundaries; there are no resorts or lodges in the park.

To determine the importance of fishing to campers at the two parks, use was made of the 1978 Provincial Park Camper Survey, which asked campers a number of questions about their recreational habits. Their answers to the two most appropriate for our purposes are summarized as follows:

	RECREATIONAL ACTIVITY MOST TIME SPENT DOING		PARTICIPATION RATES FOR SELEC RECREATIONAL ACTIVITIES	
	(% of CAMPERS)		(% of CAMPERS)	
	ALGONQUIN PARK	KILLARNEY PARK	ALGONQUIN PARK	KILLARNEY PARK
Picnic	0.9%	0.5%	36.0%	35.0%
Swim, Wade	12.5%	20.7%	74.9%	89.5%
Motorboat	0.9%	0.0%	6.4%	2.6%
Canoe	18.7%	31.2%	51.6%	72.7%
Fishing	8.0%	1.0%	38.1%	21.4%
Trail Hike (non-guided)	18.4%	13.0%	66.2%	76.0%
Bicycle	0.9%	0.0%	7.9%	8.8%
Casual Play	3.8%	2.6%	45.2%	42.9%
Relaxing	25.7%	22.0%	80.3%	80.6%
Visit Viewpoints, Scenic Lookouts	1.2%	1.3%	54.3%	64.7%

There are three major conclusions to be drawn from this table. The first is that, although a considerable proporiton of campers may spend some time fishing, it is a much smaller number who actually spend most of their time fishing. In Algonquin, where the fishing is of reasonably high quality, less than 25% of those who fished did it more than any other activity. The second conclusion is that the patterns in fishing activity shown in the survey are generally reflective of the qualtiy of the resource; resource quality will be discussed in the next section. Finally, there are a number of activities which campers prefer to fishing, and these activities are quite similar to those identified by cottagers in the Huntsville, Haliburton, Moon River and Sudbury areas. There is, perhaps, a greater emphasis on canoeing and hiking by campers, but these seem to be the only major differences.

2. The Resource Base

According to the Algonquin Provincial Park Superintendent, the quality of fishing in the park has not deteriorated to the extent of many of the areas surrounding the park. He stated that the catch per unit (CUE) is holding fairly steady for lake trout, brook (speckled) trout and smallmouth bass, in most lakes in the park. Our figures in Exhibit VI-2 for Opeongo Lake would certainly support this conviction. It should be realized, however, that Opeongo Lake is probably one of the best fishing lakes in the park. Camper survey data described in the last section show the fishing participation rate of campers is 61.8%, certainly much higher than the park average of 38.1%.

Declining water quality due to acidification is felt to be a major problem by the park superintendent, even though CUE levels are holding fairly steady. In some lakes, the pH of the lowest depths has gone as low as 4.5 in the spring. This seasonal pH depression level is thought to be far more significant in assessing acidity than a mean annual pH level for the lake. The superintendent believes that the 'saving grace' for the park lake is that the Ministry has jurisdiction over the headwaters of the major water systems in the park, and that the trout season is highly regulated, with little fall (spawning period) fishing.

In Killarney Park, the fishing was once very good, but has declined to the extent that only the toughest species such as rock bass and yellow perch endure. Species that were once in the park include lake trout, and smallmouth bass. Stocking programmes have not been successful. The Ministry of Natural Resources attributes the decline in the quality of the resource intially to the over-fishing that had taken place after the construction of the Killarney Highway, but more recently to the increases in acidity brought on by emissions from the Sudbury complex. In 1969, pH readings from the 12 major lakes in the park ranged from 4.8-7.1, averaging 5.8. As shown in Exhibit VI-2, the pH of Killarney Lake is 4.6 at present, it has a negative buffering capacity, and catch per unit effort data are considered 'not applicable'.

Asked if there were any fish in the park, the Sudbury district biologist stated that there were probably some of the hardier species in 3 of the interior lakes (Three Narrows, Heler, Low), but the fishing is not very good and is done mainly by day-users snowmobiling to the lakes in winter. He said that the park users rarely fish in the park; occasionally, a few go to Georgian Bay at Killarney, but the numbers are very small. It was his opinion that most people who visit Killarney Park are not there for the fishing. The camper survey supports this assertion.

3. The Response to Changes in the Resource Base

Asked about the effects of a significant decline in the quality of fishing, the Algonquin Park superintendent thought that for the major part of the camp season, i.e. July-August, such a decline would have little effect on park use by campers. As shown in the Camper Survey, activities such as trail hiking, canoeing, swimming and relaxing are more important to campers, particularly at this time of year. Nevertheless, there would probably be a significant impact on campers in late April and May, and again in September, when fishing assumes a greater importance. It should be realized, however, that not all people camping in this cooler weather are fishermen; some people camp and canoe at that time to avoid the black flies of the warmer months. A further consideration is that April, May and September, according to Ministry estimates, probably account for less than 20% of the park's total camper nights. The likely impact, then, would be quite small in relation to total camping activity.

Effects on Algonquin day-users would also be small. According to the 1977 Provincial Park Day User Survey, only 2.8% of Algonquin day users indicated that fishing was the activity they spent the most time doing; the fishing participation rate is 7.5%. More important activities included trail hiking, viewing historical or natural displays, relaxing, picnicking and swimming.

In Killarney Park, unfortunately, it is no longer possible to have a major decline in the quality of fishing; the decline has already taken place. It is interesting to note the response in terms of recreational activity in Killarney park. Ontario Provincial Parks Statistics 1979 published occupancy rate statistics for all the provincial parks. The following statistics on the average % occupancy on weekends show that the George Lake Campsite area of Killarney Park compares quite favourably to Algonquin Park as a whole, even in the spring, when fishermen would be expected to be at Algonquin but not Killarney.

WEEKEND AVERAGE % OCCUPANCY - 1979

	MAY	MAY JUNE	JUNE JULY	JULY	JULY AUG.	AUG.	AUG. SEPT.
	18-20	25 23	29 1	6-28	29 2	3-25	31 2
Algonquin Park	46%	9%	97%	77%	95%	72%	70%
Killarney Park (George Lake)	41%	11%	93%	91%	95%	91%	81%

Source: Ontario Provincial Parks Statistics 1979

A direct comparison in seasonal use between the parks may not be fair, since George Lake is a highly accessible site, whereas the Algonquin statistics include non-road sites as well. Nevertheless, it can be seen that visitation to Killarney Park has held up quite well, at least in the most accessible areas. This may have implications for Algonquin Park, with a great number of its visitors concentrated along the Highway 60 Corridor. At both parks, there is much more to attract visitors than the fishing alone.

The case studies have proven useful in understanding the potential effects of acidification of the aquatic environment. The major conclusion that can be drawn is that each area will be affected in different ways.

Areas where the predominant use is by cottagers will not experience much of a decline in activity, if only the fish resource deteriorates. Most cottage areas already have made the adjustment to poorer quality fishing. In addition the quality of the fish resource is one of the less important factors determining the desirability of a cottage. If acidification should effect the desirability for water contact activities through a deterioration in water quality, significant effects are likely to be experienced in cottage areas. Declines in the desirability of cottage ownership are likely and thus values of cottage properties and levels of usage could fall.

Resorts that still offer fishing as a major attraction would be affected more severely by a decline in fish quality. As most of these types of establishments are located in isolated locations, it would be difficult for their owners to make a transition to a different type of operation such as the family vacation market. In cases where the guests are predominantly non-resident the problem is even more severe as good quality fishing is the attraction, unique to much of Ontario, that attracts visitors from a long distance.

EXHIBIT VI-2

FISHING RESOURCE AND WATER QUALITY DATA

CASE STUDY AREAS

	Sudbury Area			Parry Sound Area	Haliburton Area		Huntsville Area			Provincial Parks	
	Chiniguchi Lake	Clearwater Lake	Kukagami Lake	Moon River/ Woods Bay	Kennisis Lake	Lake Kashagawigamog	Dickie Lake	Harp Lake	Lake of Bays	Algonquin (Opeongo Lake)	Killarney (Killarney Lake)
FISHING RESOURCE DATA											
CUE(1 (kg/hr)	N/A	N/A	0.04	0.01	0.09	0.07	-	-	.09	0.30	N/A
MSY(2 (kg/hr/yr)	0	0	-	-	1.58	2.69	3.15	1.56	1.19	1.54	0
Sport Fish Species(3											
Pickerel (Walleye)			X	X		X					
Northern Pike				X							
Maskinonge				X		X					
Smallmouth Bass			X	X	X	X	X	X	X	X	
Largemouth Bass						X					
Yellow Perch	x		X		X	X	X		X	X	x
Lake Trout			X		X	X		X	X	X	
Brook Trout						X		X	X		
Whitefish			X			X			X	X	
WATER QUALITY DATA											
pH(4	4.4	4.4	5.3	5.9-6.7	6.2	7.1	5.8	6.0	6.8	6.4	4.6
TIA(5	-40.6	-40.0	-4.2	76.0	34.2	450.0	15.8	70.4	27.3	110.0	-27.8
TDS(6	-	55.0	-	39.4	31.0	58.0	31.0	31.5	33.0	34.0	-

SOURCE: TIA data taken from Acid Sensitivity Survey, Ministry of the Environment, November 1980. All other data were derived based on the Ontario Lakes Survey, Ministry of Natural Resources, updated to 1980, and discussions with Ministry personnel.

1) Catch per unit effort, a measure of fishing success.

2) Maximum sustainable yield, a measure of the optimum productivity of the lake.

3) x = Minor presence X = Major presence

4) A measure of acidity.

5) Total inflection point alkalinity, a measure of buffering capacity.

6) Total dissolved solids, a meaurement by weight of the total amount of material dissolved in water.

N/A = Not Applicable - = Data not available

EXHIBIT VI-3

INTERVIEW GUIDE USED DURING CASE STUDY INTERVIEWS

RESPONDENT GROUP	QUESTIONS
Ministry of Industry and Tourism Local Offices, Tourist Associations, Municipal Clerks.	- Could you tell me some of the history of tourism in the area, with particular reference to the case study areas? What have the major trends in tourism here been in recent years? - What are the main things that would attract people to the case study areas? - What are the main activities that people would participate in when staying in the case study areas? - Where do tourists in these areas come from? - What are the main species fished for in the lakes? Has the quality of fishing changed in recent years? Why? How has that affected operators in the area? - How would a significant decline in the quality of the fishing resource affect tourist operations in the area?
Resort/Campground Operators	- Could you tell me some of the history of your resort/campground, and the nearby lake(s)? - What are the main things that attract people to your resort/campground? - Where do your clientele come from? - What have the major trends been in recent years in your industry? - Do you promote fishing in your brochures and advertising? Why or why not? - What are the main species fished for in your lake? Has the quality of fishing changed in recent years? Why? How has that affected your operation? - How important is fishing to your guests? Has this changed in recent years? Why? - How would a significant decline in the quality of the fishing resource affect your operation?

EXHIBIT VI-3
(cont'd)

RESPONDENT GROUP	QUESTIONS
Realtors	- Could you tell me some of the history of cottage and resort development on the case study lakes? - If you had a similar cottage on case study lake A and case study lake B, how would they compare in terms of demand and price? Why? - What are the major features that sell cottages in this area? - What are the recent trends in cottage demand in this area? - What is the split between year round residents, year round cottagers, and seasonal cottagers? How has this changed in recent years? - What are the major recreational activities of cottagers on the case study lakes? - What are the major species fished for in the case study lakes? Has the quality of fishing changed in recent years? Why? - How important is fishing to cottagers? If there was a significant decline in the quality of fishing, how would this affect the cottage market on the case study lakes?
Cottagers' Association	- Could you tell me some of the history of cottage development on your lake? - Could you give me some idea of the number of cottages on the lake, and the breakdown between year round residents, year round cottagers, and seasonal cottagers? - What are the major reasons people buy cottages on your lake? - How important is fishing to cottagers on your lake? What species do people fish for? Has the quality of fishing changed in recent years? Why? - How would a significant decline in the quality of fishing affect cottagers' activity patterns and the cottage market on your lake?

EXHIBIT VI-3
(cont'd)

RESPONDENT GROUP	QUESTIONS
Provincial Parks Officials	- Could you tell me some of the history of the development of the park? - What are the main things that attract day/over-night visitors to the park? - Where do the park visitors come from? - Could you describe the seasonal variation in number of visitors? - What are the major activities of day/overnight visitors? - What are the main species fished for in the park? Has the quality of fishing changed in recent years? Why? - How important is fishing to day/overnight visitors? Has that changed in recent years? - How would a significant decline in the quality of the fishing resource affect park visititation?

APPENDIX VII

CALCULATING THE ECONOMIC EFFECTS OF ACIDIFICATION OF THE FISH RESOURCE

VII. Calculating the Economic Effects of Acidification of the Fish Resource

The methodology for estimating the potential reduction in expenditures as a result of the reduction in angler effect consist of two steps. First, the percent change in potential angler effort is calculated for each of the regions (Appendix V). Then this percent decline is applied to the estimated expenditures for fishing in each of the current and two future scenarios (Exhibit VII-1 - VII-3). These calculations exclude productivity in the Great Lakes and Hudson and James Bay. The user data however includes participation on these water bodies. No attempt has been made to correct for this as in the area of potential acidification, these water bodies contribute very small amounts of the total sport fishing effort. They are also insensitive to the effects of acidification.

The indirect and employment losses are calculated using the multipliers and expenditure to employment ratios that are discussed in Appendix III. An estimate has also been made of the loss in expenditures to Ontario by the reduction in non-resident expenditures (Exhibit VII-4). This estimate has been made by applying the percent decline in fishing effort to the non-resident expenditures for each region under the current and future scenarios.

Also as has been discussed elsewhere, no attempt has been made to calculate different responses by different types of users. Further work will likely demonstrate that each of the major user groups are likely to respond differently to changes in resource quality.

EXHIBIT V11-1

CURRENT ECONOMIC EFFECTS OF ACIDIFICATION OF THE FISHING RESOURCE

Area	Reduction in Angler Effort %*	Reduction in Direct Expenditures (000's)**	Reduction in Direct & Indirect Expenditures (000's)***	Man-Years of Employment Potentially Effected By Direct Expendiutres Decline****
Parry Sound, Muskoka, and Haliburton	-3.2	$ 824	$1,318	37 man-years
Acid Sensitive Eastern Ontario	-	-	-	-
Northeastern	-4.6	1,859	2,788	84
Northwestern	-	-	-	-
Total Ontario	-0.9*****	2,683	4,106	121

* calculated from Exhibits V-7 to V-12, total loss for each area divided by total efforts in each area.

** calculated by applying % decline in angler effort to total expenditures in each area for Exhibits III-11, 14, 17 and 20.

*** calculated by applying multipliers from Appendix III, p.7 to estimate of direct expenditures.

**** calculated by dividing estimate of reduction in direct expenditures by estimates of expenditures per man-year of employment Appendix.III, p.8.

***** Exhibit V-13.

EXHIBIT V11-2

ECONOMIC EFFECTS UNDER INTERMEDIATE SCENARIO OF ACIDIFICATION OF THE FISHING RESOURCE

Area	Reduction in Angler Effort %	Reduction in Direct Expenditures (000's)	Reduction in Direct & Indirect Expenditures (000's)	Man-Years of Employment Potentially Effected By Direct Expenditures Decline
Parry Sound, Muskoka, and Haliburton	-28.2	$ 7,261	$11,618	330 man-years
Acid Sensitive Eastern Ontario	-1.9	795	1,272	35
Northeastern	-11.3	4,567	6,850	208
Northwestern	-1.7	734	1,028	33
Total Ontario	-4.1	13,357	20,768	606

EXHIBIT V11-3

ECONOMIC EFFECTS UNDER WORST CASE SCENARIO OF ACIDIFICATION OF THE FISHING RESOURCE

Area	Reduction in Angler Effort %	Reduction in Direct Expenditures (000's)	Reduction in Direct & Indirect Expenditures (000's)	Man-Years of Employment Potentially Effected By Direct Expenditures Decline
Parry Sound, Muskoka, and Haliburton	-82.3	$21,191	$33,906	963 man-years
Acid Sensitive Eastern Ontario	-12.5	5,230	8,368	227
Northeastern	-28.7	11,598	17,397	527
Northwestern	-16.5	7,149	10,009	325
Total Ontario	-17.8	45,168	69,680	2,042

EXHIBIT V11-4

ESTIMATE OF ANNUAL REDUCTION IN NON-RESIDENTS DIRECT EXPENDITURES

Area	Current Non-Resident Expenditures* (000's)	Estimated Reduction in Expenditures**		
		Current (000's)	Intermediate (000's)	Worst Case (000's)
Parry Sound, Muskoka, and Haliburton	$ 3,778	$121	$1,065	$3,109
Acid Sensitive Eastern Ontario	7,938	-	151	992
Northeastern Ontario	7,458	343	843	2,140
Northwestern Ontario	26,212	-	446	4,325
Non-Sensitive	11,416	-	-	-
Total	56,802	464	2,505	10,566

* Exhibits III-11, 14, 17, 20, 23

** calculated by applying estimated % loss in effort to current estimates of non-resident expenditures as contained in Exhibits VII-1, 2, 3.

APPENDIX VIII

AN ALTERNATIVE APPROACH TO ESTIMATING THE VALUE OF LOST RECREATION AND RESOURCES

APPENDIX VIII

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VIII. AN ALTERNATIVE APPROACH TO ESTIMATING THE VALUE OF LOST RECREATION AND RESOURCES

A. INTRODUCTION

The approach most often used in estimating the detrimental economic effects of lost recreation resources when these are considered as public goods, is based on change in direct and indirect expenditures. It can be seen that, while this might provide a sound basis for determining change in income and, therefore, be useful in comparing alternative courses of action, it does not provide the basis for valuing resources. Calculation of value that is based purely on changes in expenditures would be an underestimate because of the failure to take account of some consumers' willingness to pay more than the market price. This is illustrated by Exhibit VIII-1, shown on page 8 of this appendix. Analysis has been undertaken in a number of case studies* to develop values for recreational resources based on an approach to developing a shadow price for unpriced public goods such as recreation. This appendix develops an estimate of the value of the change in resource quality resulting from acidic precipitation based on this approach.

This appendix discusses four aspects of the analysis: the development of a shadow price for recreation; the theoretical basis for estimating lost consumer benefit; the analytical approach and the results and, finally, the limitations of the analysis.

B. DEMAND FOR RECREATION

An ingenious method for measuring the demand and value of recreation resources which were unpriced was proposed by Marion Clawson (1959). The key to this approach is the recognition that, while there is no direct charge for the use of the resource that the recreational user enjoys, the price can be developed on the basis of the cost to the user of accessing the resource. The cost of travel is a function of both distance and time. Therefore, as a general rule, the further the recreationalists travel, the greater value it is assumed they place on recreational experience and, therefore, on the resource to which they travel. Both the cost of the journey and the value that is placed on the time is reflected in this calculation.

The significance of this approach, which was further refined by Clawson and Knetsch, is that it allows a relationship to be established between the number of visits to a recreational resource and the price of access. The development of this price/quantity relationship allows the construction of a demand function.

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* Clawson, M. and J.L. Knetsch, Economics of Outdoor Recreation, Resources for the Future Inc. The Johns Hopkins Press, 1971.

The Clawson-Knetsch method is called the "travel cost method of demand estimation". In simple terms the procedure is as follows:

1. For a given recreational location, the surrounding area is divided into concentric circular zones for the purpose of measuring the travel cost from each zone to the location of the resource.

2. The number of visitors to the location are calculated by each zone of origin.

3. A travel cost measure is constructed to indicate the cost of travel from the zone of origin to the location of the recreational facility and return.

4. Visitation rates are determined on the basis of the population living within the zone of origin in relation to the numbers visiting the recreation facility. (A further refinement would be to examine the effect of other social economic variables on the propensity to travel, i.e. income, age, and education.)

5. A demand curve is constructed on the basis of the relationship between the visitation rate for each zone of origin and the cost of travel from each zone of origin.

A key step in this analysis is determining the value that should be placed on the trip to the recreation facility. Clawson's traditional approach was one of just including within the analysis the out-of-pocket expenditures that the recreational user would have to make, i.e. the cost of running the automobile and the expenditures on food during the trip. However, the matter of value of travel has been examined in a great deal of detail in a number of different contexts.

This issue was considered by N.W. Mansfield in his study of "The Estimation of Benefits from Recreational Science and the Provision of a New Recreational Facility".* In the discussion by Mansfield, he concluded that the travel costs of a journey to a recreational site includes the expenditure of both time and money and the fundamental question is what value should be placed on each element. He further concluded that motorists are responsive to variations in journey time to a recreational area even though some of the journey may be considered as part of the recreation experience and that the value placed on time would vary according to circumstances.

There is further debate on the value attributable to vehicle operating costs. One can, on one hand, take the full operating costs of the automobile including all depreciation and maintenance costs. If a motorist owned solely for recreation trips, this may be the effective marginal operating cost. At the other extreme there is the basic cost of gasoline. Mansfield addresses this problem and concludes that "one is measuring utility" when calculating consumer surplus and, therefore, costs should be valued at what the automobile user thinks they are paying, not necessarily what they actually pay. The values that were used in this study for travel cost and the value of travel time were discussed with Mr. Lucey of the Ministry of Transportation and Communications because of the extensive amount of work that has been undertaken by this Ministry on the value of travel time for cost/benefit studies.

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* Regional Studies, Volume V, 1971.

C. OUTLINE OF ANALYTICAL CONCEPT

A key part of the concept that is used in calculating the value of the deterioration in the natural resource is that of "consumer surplus". It should be noted that this concept is not without its critics. For instance, Little (1975) stated that is was no more than a "theoretical toy" (page 108).* According to Samuelson (1963), "the subject is of historic and doctrinal interest with a limited amount of appeal as a purely mathematical puzzle" (page 95).** However, notwithstanding this criticism it has been applied in a number of cases to address problems of concern with public goods which could not be tackled effectively using other analytical tools.

It is worth briefly describing in simple terms the concept. The market price for a good represents the maximum willingness to pay only for the last unit consumed. This can be shown graphically by reference to a demand curve. An individual demand curve traces the person's willingness to pay for each additional unit of an object. This follows from the law of diminishing marginal utility and is illustrated in Exhibit VIII-2, shown on page 8.

However, in a perfectly competitive market, everyone can buy an item for the same price. It then follows that if the ratio of prices is equal to the ratio of marginal utilities for one person, it will be equal to the ratio of the marginal utilities for all people.

The total area under the demand curve represents total consumer benefit. There are two components of consumer benefit, consumer expenditure and consumer surplus. These are shown graphically in Exhibit VIII-I. The consumer surplus is that portion of the consumer benefit that the consumer retains after paying for the good. It could be considered as the net benefit of the good to the consumer. It can generally be defined as the excess of total benefit over total consumer expenditure. Marshall defined it more precisely in 1920 as:

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* Little, I.M.D. A Critique of Welfare Economics, Oxford University Press (1957).
Sammuelson, P.A. Foundations of Economic Analysis, Harvard University Press (1963).

> "...the price which a person pays for a thing can never exceed and seldom comes up to that which he would be willing to pay rather than go without it: so that satisfaction he gets from its purchase generally exceeds what he gives up in paying away its price; and then he derives from the purchase a surplus of satisfaction. The excess of the price that he would be willing to pay rather than go without the thing, over that which he actually does pay, is the economic measure of his surplus satisfaction."

Put more simply, the existence of consumer surplus is a result of the fact that people usually are able to buy goods for less than they would be willing to pay if compelled to, because prices are held down by competition thus allowing some buyers to retain their consumer surplus.

Because there is no market price for recreation with respect to use of the resources which are considered public goods, the whole of the area under the demand curve can be considered to be for the consumer's benefit. See Exhibit VIII-3 on page 9 of this appendix.

If there is a shift in the demand curve, because for some reason demand has declined, then the area between two demand curves represents the lost benefit. Because there is no market price, this consumer benefit is not broken down between consumer expenditure and consumer surplus. See Exhibit VIII-4 on page 9. This analysis was designed to estimate the value of the lost benefit using demand curves developed using the travel cost approach.

D. APPLICATION OF THE CONCEPT

The concept for analyzing the value of the decline in the quality of the recreation resource is as follows: the attraction of the recreational resource for fishing declines as the number of fish declines. Decline in attractiveness results in a decline in demand. The analysis is therefore directed at determining the value of the decline in demand. That is the area between the demand curves. The demand curves are constructed on the basis of the travel cost approach. There are a number of key simplifying assumptions that should be noted as underlying this analysis.

1. The market for recreation is in a state of equilibrium.
2. The variables that will affect the demand for recreation will stay constant over time.
3. Opportunities for recreation outside of the destination areas of:
    a) Parry Sound, Muskoka, Haliburton,
    b) Acid sensitive eastern Ontario,
    c) Northeastern Ontario,
    d) Northwestern Ontario

    do not significantly influence the result.

4. None of the destinations is assumed to be at the limits of its capacity.
5. Because of the limitations of the data, variables which would be expected to affect the demand for recreation other than the population of the area of origin and distance are not considered. (Such variables would be age, sex, marital status, education, and income.)

The calculation was undertaken in the following way:

1. Trips to recreational regions affected by acid rain from any other region were determined from the 1974 Ontario Recreation Survey. These trips were adjusted to estimates of 1980 volumes.
2. The zones of origins were taken as being counties and trip distance from county centroid to recreational district centroid were calculated.
3. The cost of the trip was calculated using average 1980 figure of $.15* per kilometre and average automobile occupancy of 2.7.**
4. Average travel time was calculated on the basis of 80 kilometres per hour.
5. The value of travel time was calculated using the average per capita disposable income for the province in 1980. A figure of $1.45 per hour was used and applied to all occasions.
6. The value of travel time and travel cost for each trip was totalled to give a value for each trip.
7. The decline in the number of trips from each county of origin to each regional district was calculated on the basis of the catch per unit of effort function (Appendix V).
8. The value of the lost trips was then calculated.

The results are shown in Exhibit VIII-5 and it can be seen that on this basis the value lost annually associated with the current level of damage to fishing is $11,000,000, for the "Intermediate Situation", $50,000,000 and for the "worst case" scenario, $126,000,000. It should be emphasized that these are annual estimates of losses based on 1980 figures. It should also be noted that these estimates relate only to changes related to a deterioration in the fishing resource. A large amount of recreation relates to other activities and if these activities were to decline values would be much higher.

E. LIMITATIONS TO THE APPROACH

The approach used in this analysis uses a model of behaviour which is a simplification of the real world. The approach was developed from the application of the travel cost approach to pricing used to estimate consumer benefits for specific recreation facilities. In this case we are considering the benefits to consumers at a wide range of facilities. These are grouped within the recreational districts which were used for the analysis of susceptibility to acidic precipitation.

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* Ontario Motor League average auto operating cost for 1980.

** Ontario Recreation Survey.

The limitations to the approach are both theoretical and data related. The major theoretical problem is that in the approach used, only three variables are considered to affect the demand: the catch of fish per unit of effort, the population in the zone of origin and distance.

Other research shows that many other variables will affect demand. The following is a list of variables identified by S. Law in The Demand for Outdoor Recreation in the Countryside (1970):

- leisure time,
- age, sex, marital status, family composition,
- education,
- employment,
- disposable income,
- car ownership,
- characteristics of place of residence,
- taste,
- the attractiveness of recreation opportunities,
- intensity of use,
- the availability of recreation substitutes,
- travel time and distance,
- the characteristics of the journey (comfort), and
- cost.

In the analysis undertaken here, a large number of these variables have been ignored or assumed to be neutral in their influence on the change in demand resulting from acidic precipitation because the necessary data is not available.

A further limitation is that a simple relationship is assumed between the point of origin and the destination as expressed by the simple gravity model.

$$V = \frac{PA}{d_1}, d_2 \ldots$$

where V = trips
P = propensity to participate in recreation
A = attractiveness of facility
d_1 = distance related factors

A modified view of spatial interactions was expressed by Samuel Stouffer (1940) who introduced the concept of "intervening opportunities". He stated that:

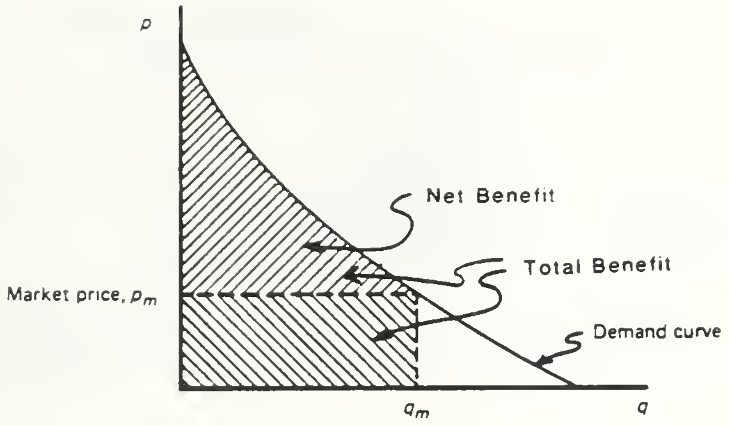
> "the number of persons going a given distance is directly proportional to the number of opportunities at that distance and inversely proportional to the number of intervening opportunities. Another way of stating the same hypothesis is that the number of persons going a given distance is directly proportional to the percentage increase in opportunities at that distance."

When this concept is considered, it is easy to see that relationships exist between all origins and all destinations in a manner that is more complex than the relationship represented by the gravity model. Assuming the system can be considered to be in equilibrium, a change in the attractiveness of any destination will have an impact which will affect all other destinations. In order to properly identify such an impact, the nature of the interactions between origins and destinations would have to be modelled (in a manner similar to that used in a transportation study).

In order to test the significance of the analysis that was undertaken, regression lines were fitted to the data on visitation rates and the distance between the zones or origin and the recreation districts (i.e. the demand curves). The results are shown in Exhibit VIII-6. It will be noted that even though both a straight line and an exponential curve were fitted, few co-efficients of correlation were above 0.5, thus indicating that variables that significantly affected visitation had been excluded from the analysis.

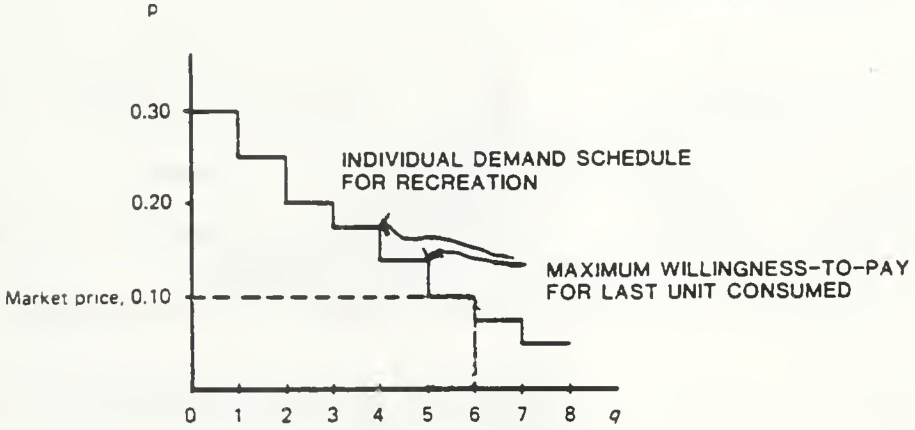
The analysis presented here is exploratory. The analysis indicates that there is a value to recreational resources above that indicated by expenditures alone but, at the same time, shows that the data and modelling required to arrive at more accurate estimates must be much more detailed.

EXHIBIT VIII-1



THE AREAS UNDER THE DEMAND CURVE REPRESENTING CONSUMER EXPENDITURE AND CONSUMER SURPLUS.

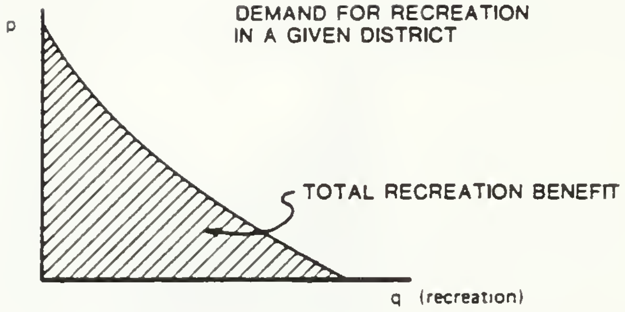
EXHIBIT VIII-2



AN INDIVIDUAL'S DEMAND SCHEDULE FOR RECREATION ILLUSTRATING THE WILLINGNESS-TO-PAY FOR THE LAST UNIT OF RECREATION CONSUMED.

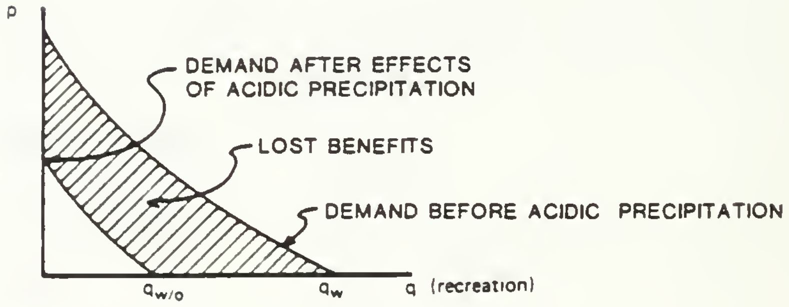
EXHIBIT VIII-3

EXHIBIT VIII-3



TOTAL BENEFITS OF RECREATION OPPORTUNITIES

EXHIBIT VIII-4



LOST RECREATION BENEFIT AS QUALITY OF ENVIRONMENT DETERIORATES AND DEMAND DECLINES

EXHIBIT VIII-5

ESTIMATED CHANGE IN VALUE OF FISHERY RESOURCE BASED ON THE TRAVEL COST METHOD

TRAVEL COSTS ($MILLIONS - 1980)

DESTINATION AREA	Total value of travel	Annual value of lost fishing occasions		
		Current level of acidification	Intermediate scenario	Worst Case scenario
Parry Sound, Muskoka, Haliburton	59	2	19	50
Acid-sensitive Eastern	56	-	1	7
Northeastern	101	6	15	24
Northwestern	87	-	2	15
	303	8	37	96

TRAVEL TIME ($MILLIONS - 1980)

DESTINATION AREA	Total value of travel	Annual value of lost fishing occasions		
		Current level of acidification	Intermediate scenario	Worst Case scenario
Parry Sound, Muskoka, Haliburton	19	1	6	16
Acid-sensitive Eastern	19	-	-	2
Northeastern	39	2	6	7
Northwestern	28	-	1	5
	105	3	13	30
Total Value of Lost Occasions		11	50	126

EXHIBIT VIII-6

Co-efficients of Correlation for Regression of Visits Per 1000 and Distance

	Co-efficient of Correlation Straight Line	Exponential Curve ($Y = kA^x$)
Near North		
Haliburton	0.16	0.19
Muskoka	0.35	0.32
Parry Sound	0.20	0.17
Eastern Ontario		
Frontenac	0.29	0.18
Hastings	0.34	0.32
Lennox and Addington	0.48	0.34
Peterborough	0.72	0.37
Northern Ontario		
Renfrew	0.22	0.37
Algoma	0.17	0.29
Cochrane	0.80	0.69
Manitoulin	0.43	0.69
Nippissing	0.42	0.41
Sudbury	0.33	0.33
Timiskaming	0.59	0.50
Northwest Ontario		
Kenora	0.40	0.72
Rainy River	0.44	0.76
Thunder Bay	0.39	0.16

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APPENDIX IX

THE ANALYTICAL FRAMEWORK

APPENDIX IX

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IX. THE ANALYTICAL FRAMEWORK

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IX. THE ANALYTICAL FRAMEWORK

As is the case with most types of environmental effects analysis, the total economic effects of acidic precipitation cannot be quantified. Throughout the main report, there are numerous references to problems encountered in the analysis. The purpose of this appendix is to comment, in more detail and in one location, on the types of information and scientific research that impedes the completion of a complete economic assessment of the effects of acidic precipitation.

The appendix consists of two major components. The first component discusses each of the seven major steps in the analytical framework. For each step, the type of analysis that can be completed is discussed as well as the additional analysis that is required to have a complete understanding of all the implications. The second part of the appendix discusses the procedures used to estimate the component of effects that are currently quantifiable.

A. COMPONENTS OF THE ANALYTICAL FRAMEWORK

As indicated in Exhibit IX-1, there are seven major steps in the analytical framework. This section discusses each of these steps focusing on both the desirable type of analysis and on the analysis that is currently possible.

1. Determine Effects of Acidic Precipitation on the Environment

To understand the implications of acidic precipitation on recreation and tourism in Ontario, it is desirable to establish the effects of various levels of acidification on both the aquatic and terrestrial environment. Both direct and indirect effects need to be understood. Because of the complex interrelationships in the environment, it is unlikely that all the implications of acidification will ever be understood.

However, based on current knowledge, the desirable framework for analysis of acidic precipitation should include the following:

- link between deposition and acidification of aquatic environment - The work undertaken in this study has been hampered by a lack of a link between levels of deposition in an area (both dry and wet) and the level of acidification of the area's aquatic environment. Until such time as the results of the calibrated watershed research efforts are available these links cannot be made. The ideal framework would provide the ability to link levels of deposition to a measure of aquatic environment acidity.

- measure of acidity - Ideally, the current pH of as many waterbodies as possible in the province needs to be determined. At the present time, estimates of pH can only be made for approximately 1,500 lakes. These 1,500 lakes are not randomly distributed throughout the province.* The implications of this lack of randomness are not understood.

- links between pH and the environment - At critical levels of pH links with the aquatic environment need to be determined both direct and indirect. A complete analytical framework would need to make the following linkages:

  - fish - direct - reproductive failure by type of species
    - sudden mortality by type of species
    - indirect - reduction in nutrients by type of species
      - heavy metal contamination by type of species
  - waterfowl - indirect - reduction in nutrients by type of species
  - moose - indirect - reduction in nutrients
  - humans - indirect - heavy metal contamination through drinking water
    - perceived effects and damages

  The framework used in the main report has only been able to quantify a link between fish populations and reproductive failure. It has also not proven possible to document the differences between the major species of fish due to lack of good species population data and data on angling activity by species.

- alternative levels of pH - A key input to any analytical framework on the effects of acidification is the ability to be able to make estimates of future levels of acidity. At present, this capability does not exist. In the framework used in this report, an attempt was made to develop some idea of the implications of future levels of acidity by analyzing two alternative scenarios, an intermediate case and the worst case. However, it should be stressed that the levels and locations of emissions required to produce these levels of acidification are not understood.

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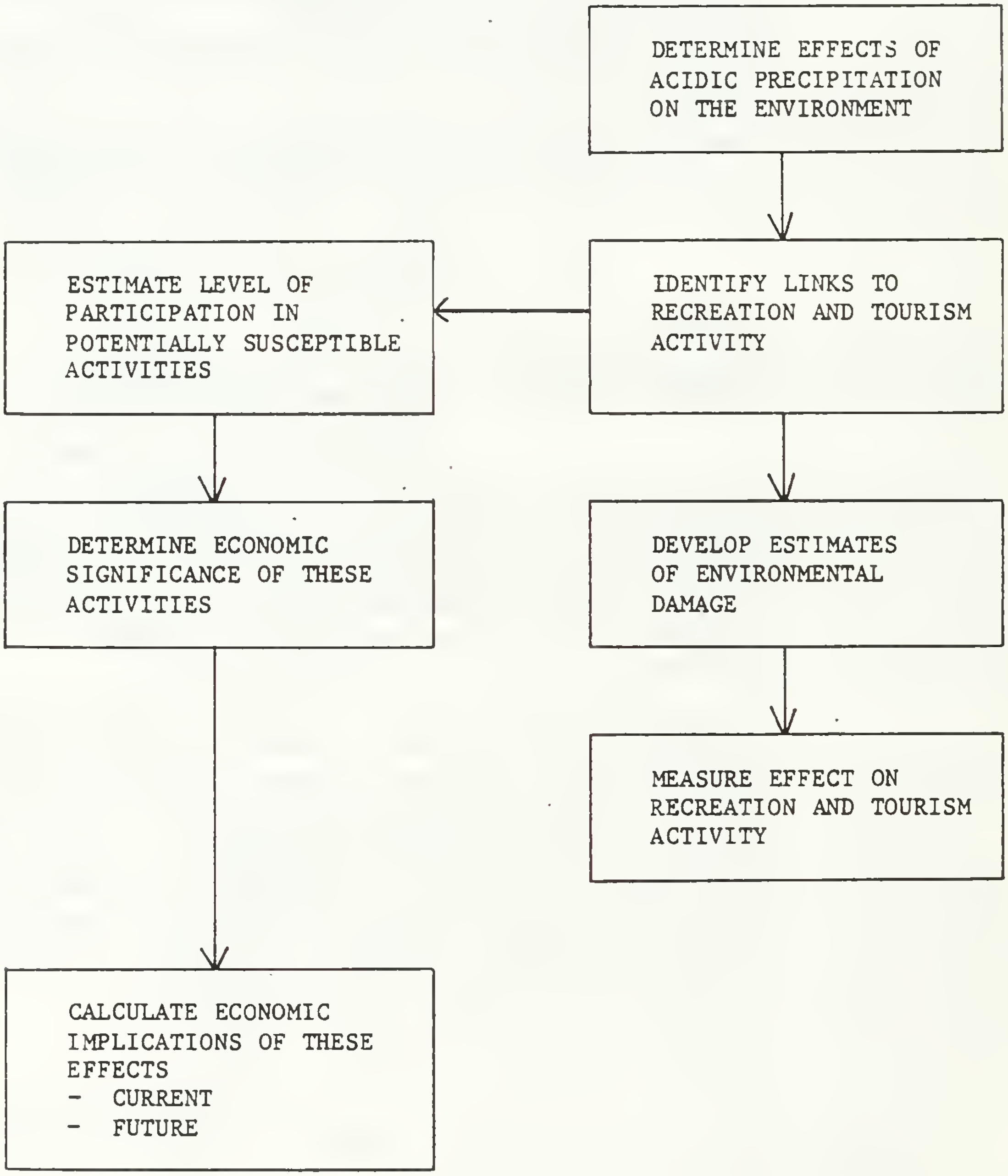
* Ontario Ministry of the Environment, Acid Sensitivity Survey of Lakes in Ontario, Toronto, MOE, March 1981.

EXHIBIT IX-1

ANALYTICAL FRAMEWORK USED IN THIS ASSIGNMENT CONSISTED OF SEVEN MAJOR STEPS


DETERMINE EFFECTS OF ACIDIC PRECIPITATION ON THE ENVIRONMENT
IDENTIFY LINKS TO RECREATION AND TOURISM ACTIVITY
ESTIMATE LEVEL OF PARTICIPATION IN POTENTIALLY SUSCEPTIBLE ACTIVITIES
DETERMINE ECONOMIC SIGNIFICANCE OF THESE ACTIVITIES
DEVELOP ESTIMATES OF ENVIRONMENTAL DAMAGE
MEASURE EFFECT ON RECREATION AND TOURISM ACTIVITY
CALCULATE ECONOMIC IMPLICATIONS OF THESE EFFECTS
- CURRENT
- FUTURE

2. Identify Links to Recreation and Tourism Activity

Any framework to analyze the implications of acidic precipitation on recreation and tourism, needs to be able to make links between the physical resource base and recreation and tourism activity. For some types of recreation and tourist activity, the relationship is fairly direct while with others, the relationships are not clear. Specifically, the following relationships need to be developed:

- fish population by fish species - fishing activity
- waterfowl population by type - waterfowl hunting activity
- moose population - moose hunting activity
- acidity of water
    - appearance
    - perceived fears to humans
    - swimming activity
    - boating activity
    - waterskiing
    - scuba diving

Of these linkages, we have only developed quantifiable linkages between fish as measured by productivity and fishing activity. Current research would also suggest links to water contact activities will be difficult to develop. These activities will be most affected by peoples' perception of the damage and not necessarily by changes in the level of acidity.

3. Develop Estimates of Environmental Damage

At this point in time, scientific knowledge only allows quantification of one type of environmental damage at various levels of pH - the reduction in fish reproduction capability. Even this calculation required that assumptions must be made. The key assumption concerned the level of fish reproductive capability lost in Category II "extremely sensitive lakes." The 20 percent loss in productivity used in this report is based upon scientific judgement. Ideally in the analytical framework, the capability should exist to also quantify the following types of environmental damage at various levels of pH.

- fish - sudden mortality as a result of acid pulses
    - implications of loss of nutrients
    - implications of heavy metal contamination
- moose - indirect effects of food supply modifications on reproductive capabilities
- waterfowl - indirect effects of food supply modifications on reproductive capabilities
- humans - effects of perceived damages and fear

4. Measure Effect on Recreation and Tourism Activity

To completely analyze the effects of acidic precipitation on recreation and tourism, we also need to be able to develop relationships between the quantity of the resource and the level of recreational and tourist activity. As well, the effects of the changing image of the natural environment due to perceived damages needs to be determined. Both of these tasks are extremely complex.

In the framework used in this study, a relationship between a potential fish harvest and level of effort has been developed. However, available information has allowed only one such function for the entire study area to be developed. It is our view that the relationship between harvest and effort expressed as a catch per unit of effort function varies throughout the province and by type of fish species.

Additionally, it would also be desirable to develop a relationship between the potential harvest or the sustainable yield of waterfowl and moose and the level of effort that hunters are willing to commit. For waterfowl, the task is extremely difficult as the location of hunting activity is not likely to be the same location as that of the damage to waterfowl populations. Additional research will be the only way to determine the effects of changing perceptions toward the natural environment.

5. Estimate Level of Participation in Potentially Susceptible Activities

This is the area of the framework where existing information allows the framework to be completed. Numerous data weaknesses will, however, subject the activity profile to criticism. For each of the key activities, except moose hunting, a profile of 1980 use has been developed. This profile includes:

- the major aquatic related activities
    - swimming
    - boating
    - fishing
    - waterskiing
    - scuba diving
    - waterfowl hunting
- by major user group
    - residents of Ontario
    - other Canadians
    - Americans
    - other foreign

- measured in terms of
    - occasions of day-use activity
    - overnight stays by major accommodation grouping
        - private cottage
        - camping
        - other commercial
        - friends and relations

This breakdown is probably the best that can be developed. As current research is suggesting that the effects of acidification on the aquatic environment will vary greatly between aquatic environments in the same area, having a framework that could provide user data for smaller geographic areas will also improve the analysis. Data for specific lakes or watersheds would be ideal. The Ontario Recreation Survey, although an excellent data source, is not based upon a large enough sample to even allow estimates for many activities to be made at the county or district level.

6. Determine Economic Significance of These Activities

There are numerous techniques for measuring economic benefits and therefore economic implication of various types of environment deterioration. Among potential approaches are: the expenditure method, value added approach, travel cost method, land value approach and the interview approach. In our view, considering the nature of acidic precipitation and the type of data that are available or likely to be available, the ideal framework should include both the expenditure approach and an approach based upon consumer surplus estimated on the basis of travel costs. In theory, these methods should be developed in such a manner that they can be summed to determine the total economic implications.

The expenditure approach examines the change in expenditure resulting from changes in behaviour patterns. This is an important indicator of impacts as it directly addresses the major concern of the residents and policy makers. The expenditure approach has a tendency in some circumstances to underestimate consumer benefits because many goods in the environment are not priced and the expenditures associated with the consumption of a resource are not a total reflection of the total value to society.

To overcome this problem, the ideal framework should include the ability to measure consumer surplus. The most frequently used method of attempting to measure this value is based on the travel cost method. During this assignment, an attempt was made to calculate consumer surplus based on the travel cost method (see Appendix VIII). However, because of limited data availability, a low level of confidence is placed upon the estimates generated in this analysis. Because of the way recreation expenditures are recorded there would be double counting of travel expenditures if consumer surplus calculations and values based on expenditures are summed.

As a result, only the expenditure approach has been used in the main report to estimate the value of aquatic based recreation and tourism. Expenditures have been estimated based upon the type of occasion for day use activity and by type of accommodation for overnight stays. Appendix III discusses the development of these expenditure estimates in detail. In keeping with many other studies of recreation and tourism, excluded are expenditures on major equipment and cottage purchase and upkeep.

7. Calculate Economic Implications of These Effects

Once the calculations are made of the reduction in the resource or desirability of other activities at various levels of acidification, it is fairly straight forward to make the links to the economic implications. In the desirable framework, a reduction in the quantity of fish, moose, or waterfowl will reduce activity in relation to an effort versus resource availability function. Based upon these relationships, changes in the level of activity can be calculated and thus the changes in expenditures are determined. However, as has been discussed elsewhere in the report, the ideal framework would differentiate between the key user types: day use, overnight by accommodation type, resident and non-resident. It is anticipated that each of these different user types would respond differently.

The desirable framework would also have the capability to calculate the economic implications of the changes in the perception of the desirability of other forms of activity as well. This will be necessary to determine the effects of acidic precipitation on water contact activities such as swimming.

The ideal framework should also have the capability to calculate a large number of other economic indicators that would be influenced by changes in direct expenditures generated by participation in recreation and tourist activities. Among these are:

- indirect expenditures
- employment
- foreign exchange contribution
- taxes - federal
    - provincial
    - local
- links to other sectors of the economy.

In Volume I of this report, estimates of indirect expenditures and employment have been made.

B. USING THE DEVELOPED FRAMEWORK

As the method of calculating current quantifiable effects is long and complex it was felt desirable to describe in one location each of the key steps used to determine the effects on reduction in fish reproduction capabilities.

1. The study area was divided into four regions:

   - Parry Sound, Muskoka, Haliburton
   - non-sensitive Eastern Ontario
   - Northeast Ontario
   - Northwest Ontario

2. For each of these areas fish productivity in kilograms was calculated by use of Ryder's formula as modified by McCombie.

3. Next, the water area of each of the four regions was classified into five acid susceptibility categories:

I	acidified
II	extremely sensitive
III	moderately sensitive
IV	low sensitive
V	not sensitive

4. On the basis of the proportion of lakes in each acid susceptibility category, fish productivity was then allocated to sensitivity categories.

5. Assumptions were made about the loss of reproductive capability by susceptibility category for the current, intermediate and worst case scenario.

	Current	Intermediate	Worst Case
		Class of Lake	
no reproduction	I	I, II	I, II, III
20% reproduction	II	III	IV
no loss	III-V	IV-V	V

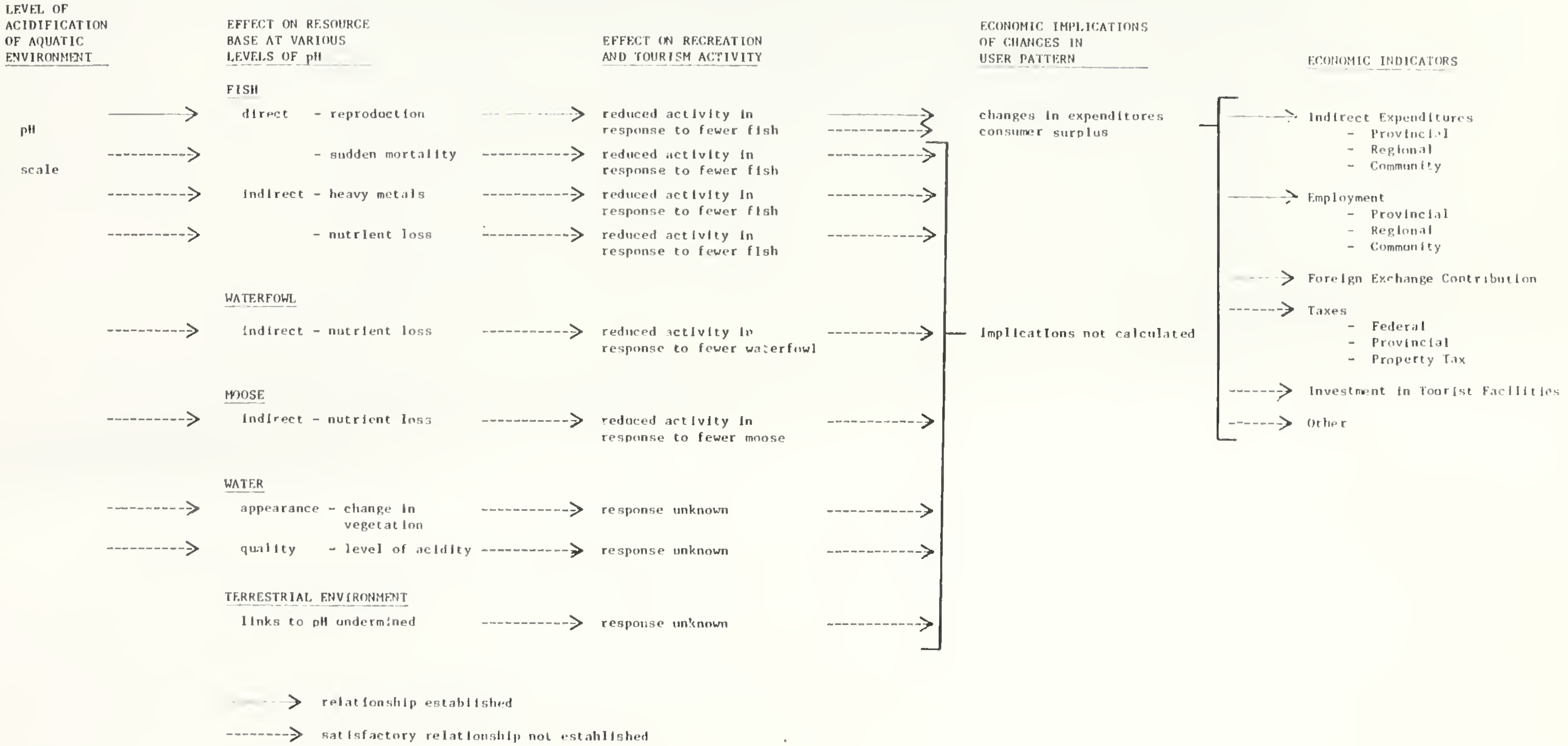
6. Losses in productivity were then calculated. By use of the catch per unit of effort function, the response of fishermen to declines in fishing quality were estimated. This is measured in terms of angler hours.

7. The percentage loss in angler effort was then calculated and total direct expenditures were then reduced by a similar percentage change. The indirect expenditures and employment lost were then calculated.

As indicated in Exhibit IX-2, this analysis has been able to analyze in detail only one of the many potential effects of acidic precipitation on recreation and tourism. Numerous additional studies need to be undertaken before the desirable analytical framework developed here can be used to ascertain a more complete understanding of these efforts.

EXHIBIT IV.2

ANALYTICAL FRAMEWORK REQUIRED TO ASSESS THE EFFECTS OF ACIDIC PERCIPITATION ON RECREATIONAL TOURISM


LEVEL OF ACIDIFICATION OF AQUATIC ENVIRONMENT
pH
scale
EFFECT ON RESOURCE BASE AT VARIOUS LEVELS OF pH
FISH
direct - reproduction
- sudden mortality
indirect - heavy metals
- nutrient loss
WATERFOWL
indirect - nutrient loss
MOOSE
indirect - nutrient loss
WATER
appearance - change in vegetation
quality - level of acidity
TERRESTRIAL ENVIRONMENT
links to pH undermined
EFFECT ON RECREATION AND TOURISM ACTIVITY
reduced activity in response to fewer fish
reduced activity in response to fewer fish
reduced activity in response to fewer fish
reduced activity in response to fewer fish
reduced activity in response to fewer waterfowl
reduced activity in response to fewer moose
response unknown
response unknown
response unknown
ECONOMIC IMPLICATIONS OF CHANGES IN USER PATTERN
changes in expenditures consumer surplus
Implications not calculated
ECONOMIC INDICATORS
Indirect Expenditures
- Provincial
- Regional
- Community
Employment
- Provincial
- Regional
- Community
Foreign Exchange Contribution
Taxes
- Federal
- Provincial
- Property Tax
Investment in Tourist Facilities
Other
relationship established
satisfactory relationship not established